Yapay zeka, nanoteknoloji, metamateryal, metayüzey ve uzaktan elektrik enerjisi aktarımının aydınlatmada görsel anlamda açmak üzere olduğu ufuklar

Dr. K. Hilmi OR, PhD, MSc , PA, FICO, FEBO, AFIAP
Hamburg / Almanya – Istanbul / Türkiye

Göz Hastalıkları Uzmanı
Adli Tıp (PhD)
Görme Yapay Görme ve Az Görenlerin Rehabilitasyonu Yüksek Lisansı (MSc)
Fotoğrafta Sanatta Yeterlik (Sanatta PhD eşdeğeri)
Fellow of International Council of Ophthalmology (FICO)
Fellow of European Board of Ophthalmology (FEBO)
Artist of International Federation of Photographic Art (AFIAP)
Aydınlatma Türk Milli Komitesi Bireysel Üyesi (ATMK)
Aydınlatma Alman Milli Komitesi Bireysel Üyesi (DNK-CIE)
Uluslararası Renk Federasyonu Bireysel Üyesi (AIC)
Medya ve İletişim Ön Lisansı
Web Tasarım ve Kodlama Ön Lisansı

Yapay zeka, nanoteknoloji, metamateryal, metayüzey ve uzaktan elektrik enerjisi aktarımının aydınlatmada görsel anlamda açmak üzere olduğu ufuklar

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Görsel İletişim Tasarımı Lisans Öğrencisi
İnformatik Lisans Öğrencisi

Almanya'da tamamlanan diğer eğitimler:
Yeterlilik belgesi "Tıbbi değerlendirme"
Yeterlilik belgesi "Trafik hekimliği"
Yeterlilik "Uzmanlığa Bağlı Nörosensöriyel Genetik Danışmanlık"

Finansal ilinti beyanı

Sunumda ismi geçen
herhangi bir firma ya da ürün ile ilgili
herhangi bir maddi ilişkim veya çıkarım
bulunmamaktadır.

İnterdisipliner

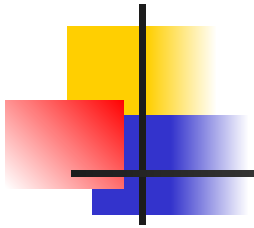
- İnterdisipliner:
- farklı disiplinlerden araştırmacılar birlikte

İnterdisipliner / Transdisipliner

- İnterdisipliner:
- farklı disiplinlerden araştırmacılar birlikte

- Transdisipliner:
- farklı disiplinlerden araştırmacılar uygulayıcılarla birlikte

Fotonik



- Işığın üretilmesi
- farklı ortamlarda yayılması
- ışığın şiddeti, rengi gibi özelliklerinin değiştirilmesi veya işlenmesi
- ölçülmesi

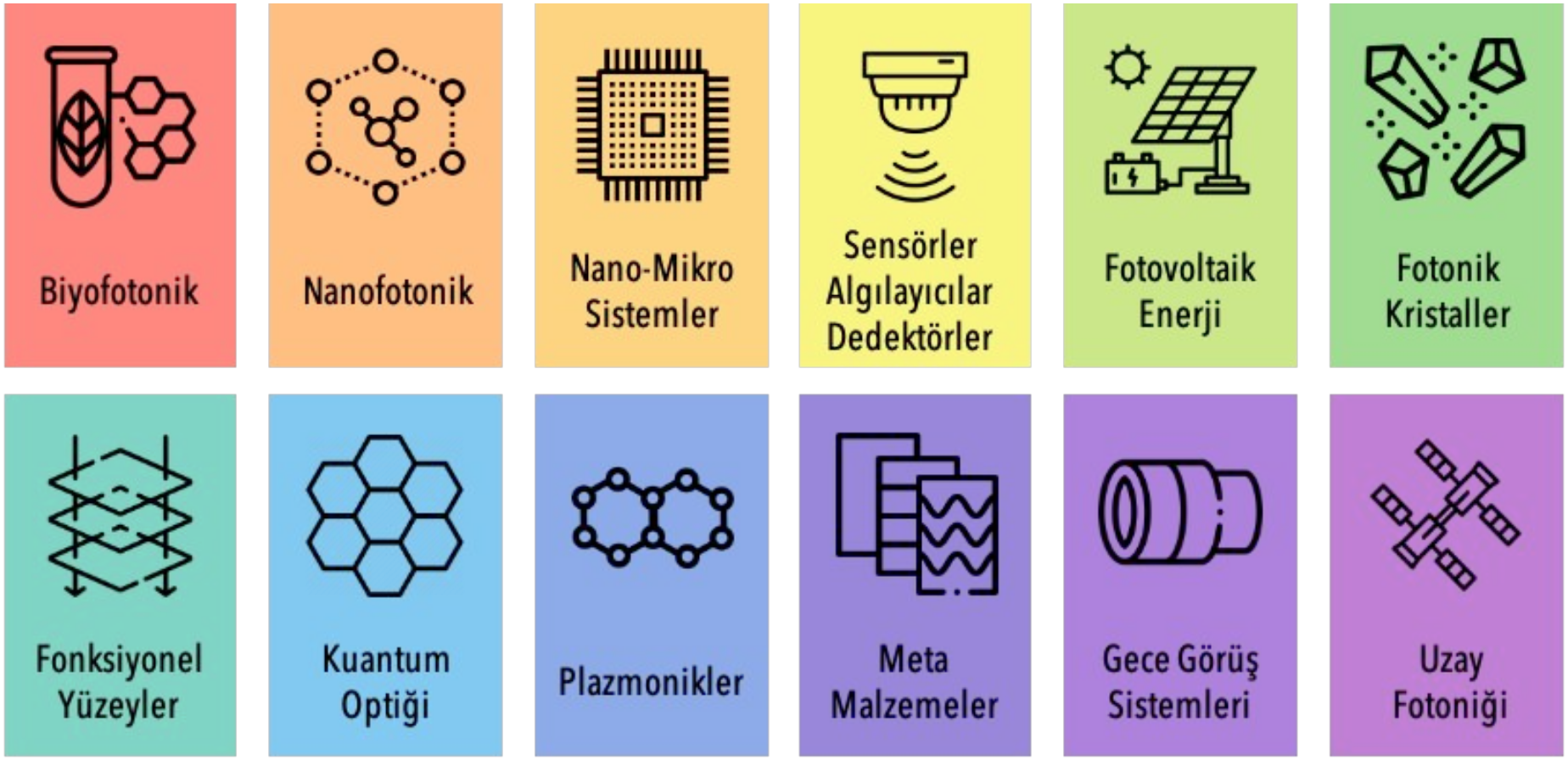
Fotonik
21. yüzyılın bilimi

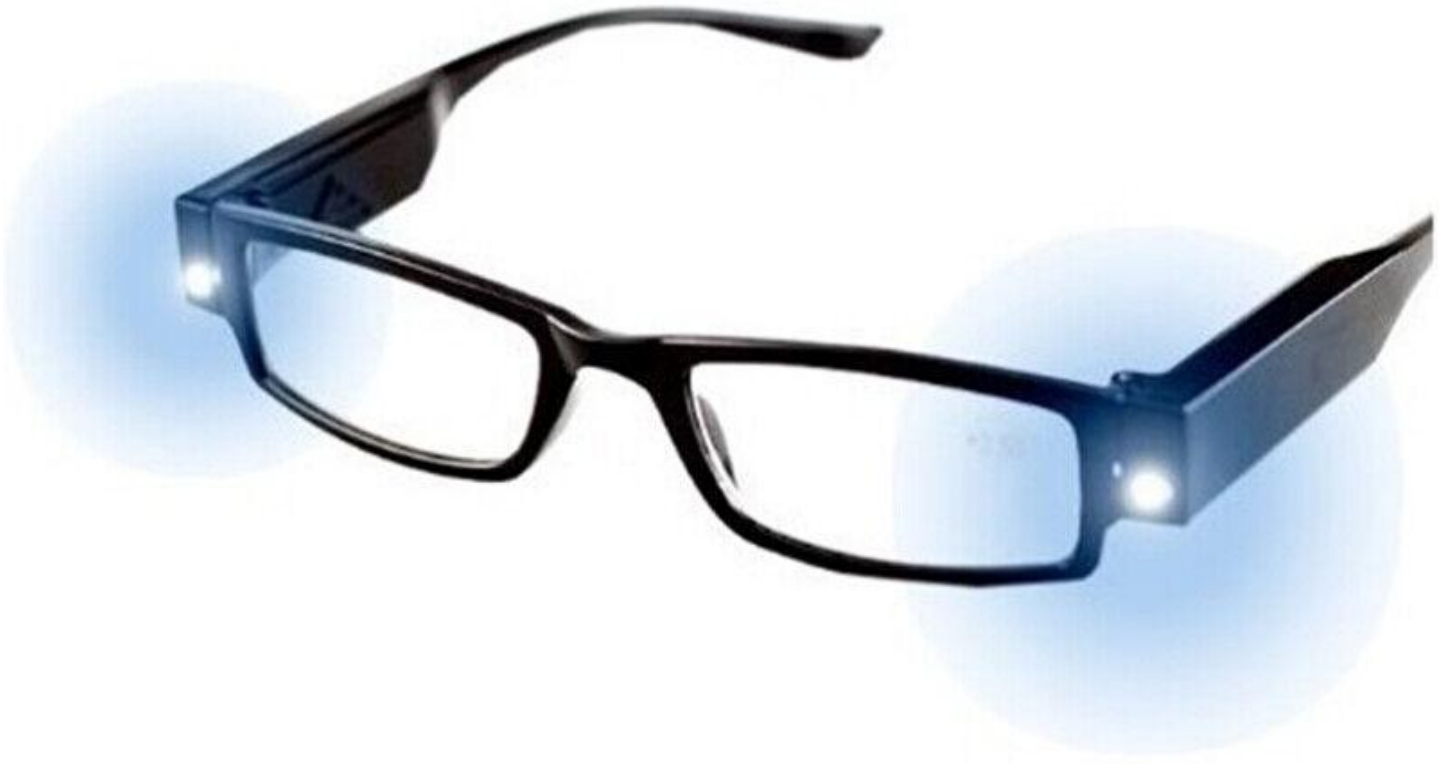
- Işığın üretilmesi
- farklı ortamlarda yayılması
- ışığın şiddeti, rengi gibi özelliklerinin değiştirilmesi veya işlenmesi
- ölçülmesi

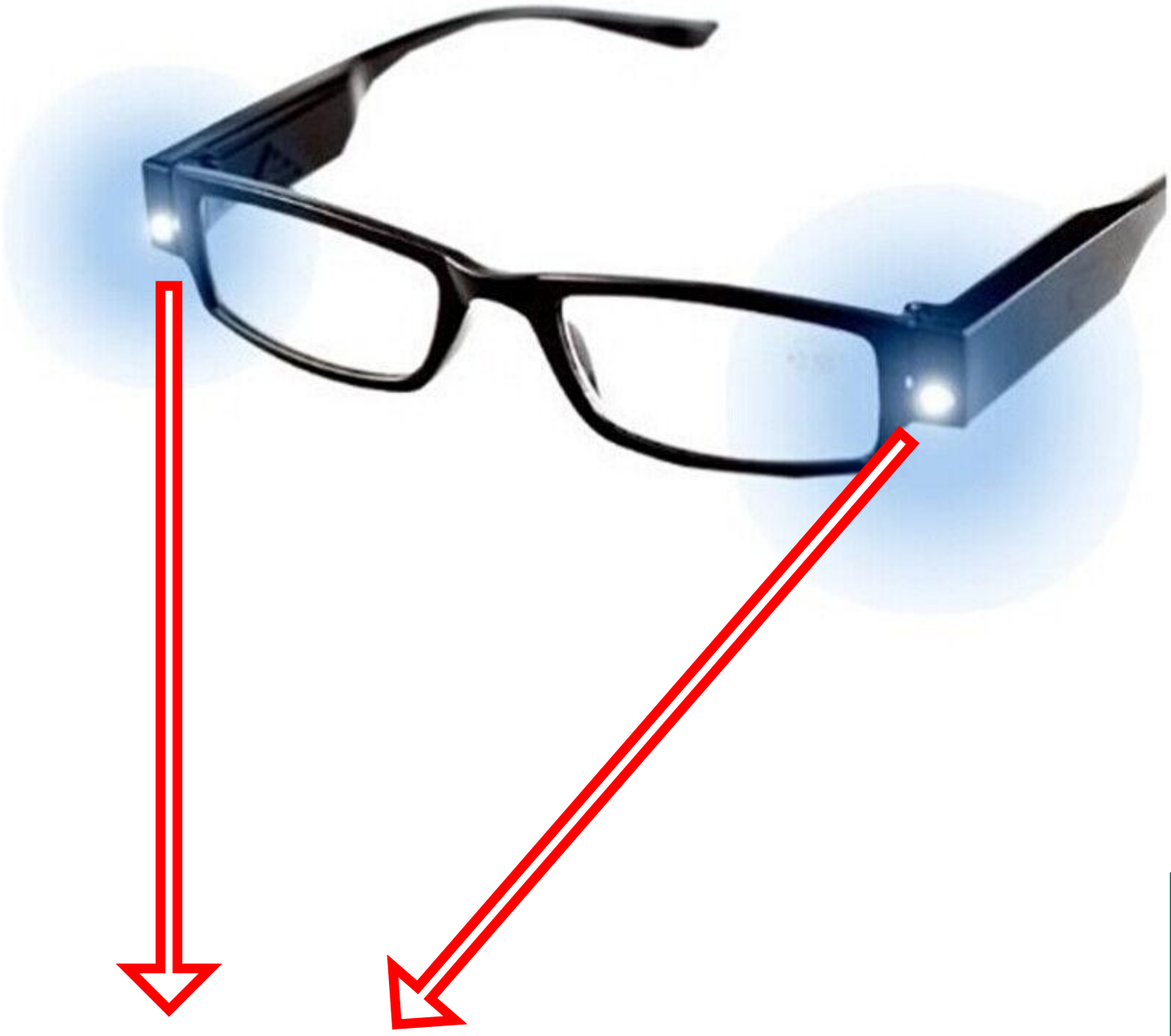
- Bilim ve teknoloji:
- Işığın kuantum birimi olan fotonun kontrolü

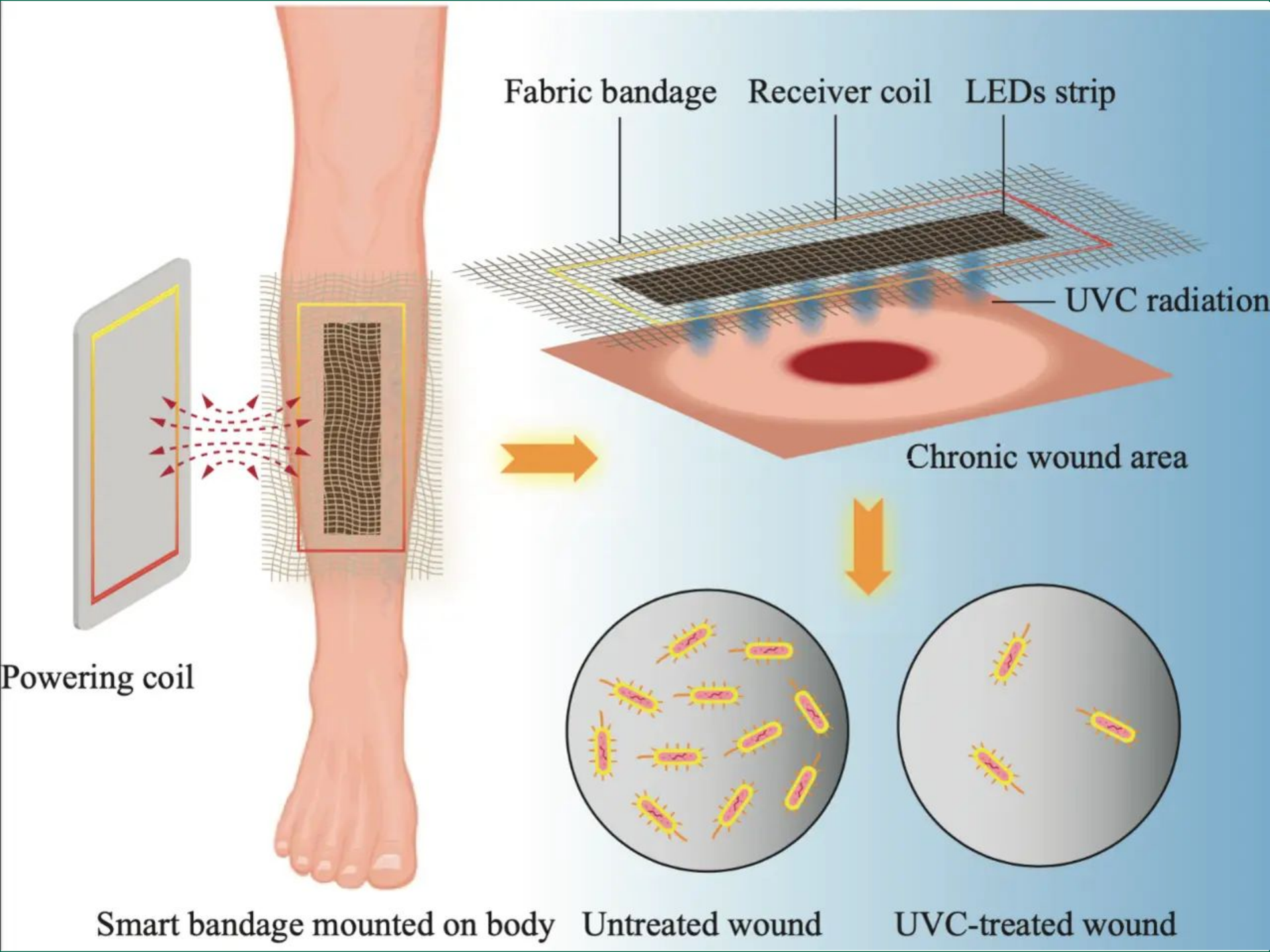
Fotonik

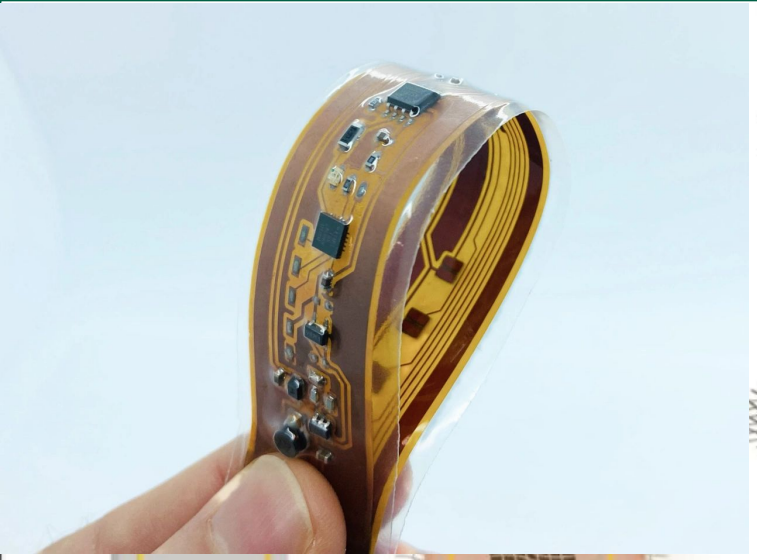
https://ubf-fotonik.gazi.edu.tr/view/page/254524

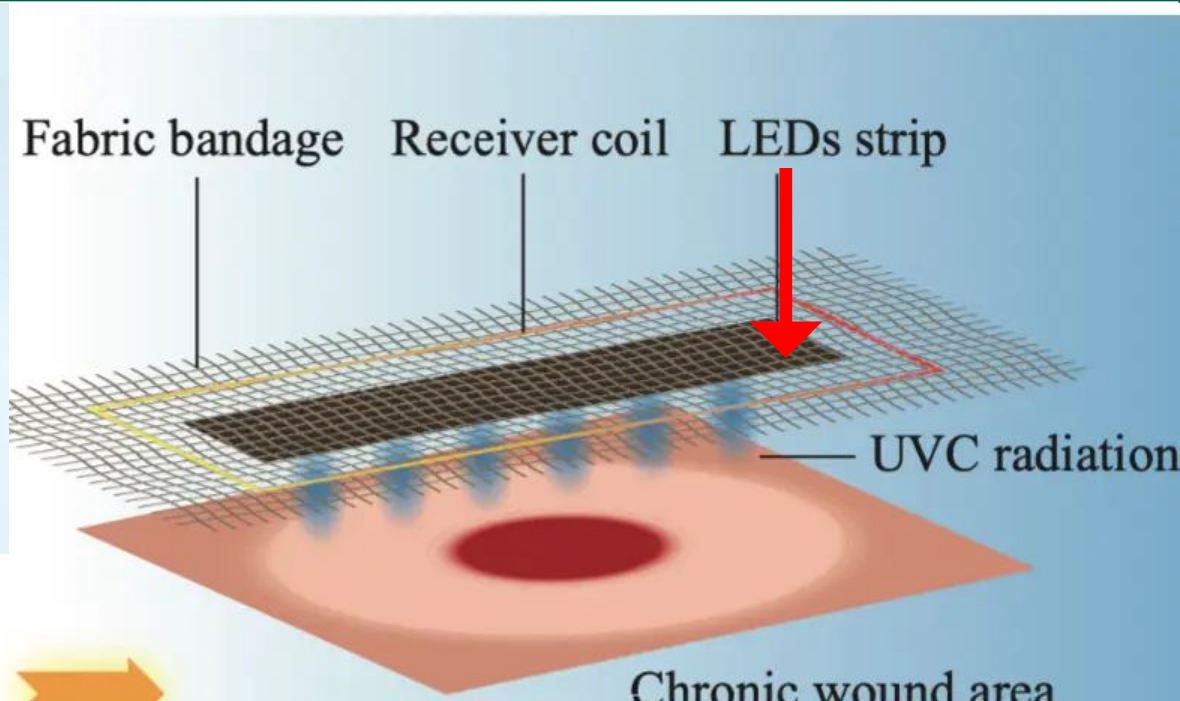


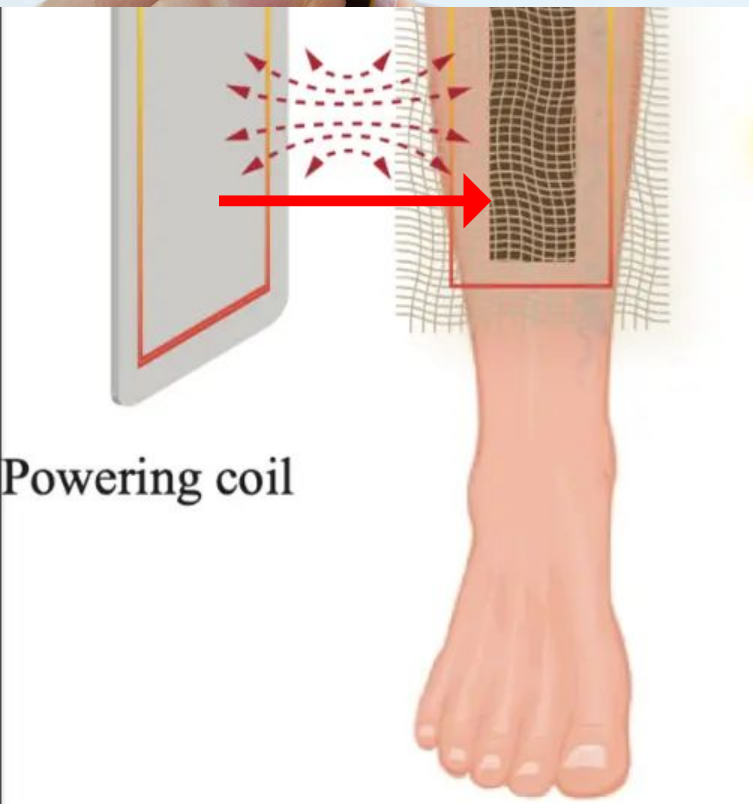


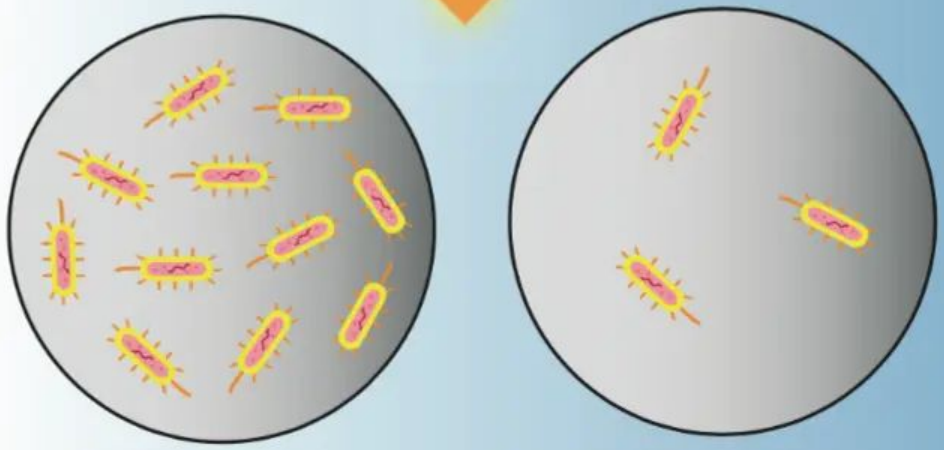



Fabric bandage
Receiver coil
LEDs strip
UVC radiation
Chronic wound area
Powering coil
Smart bandage mounted on body
Untreated wound
UVC-treated wound









Smart bandage mounted on body

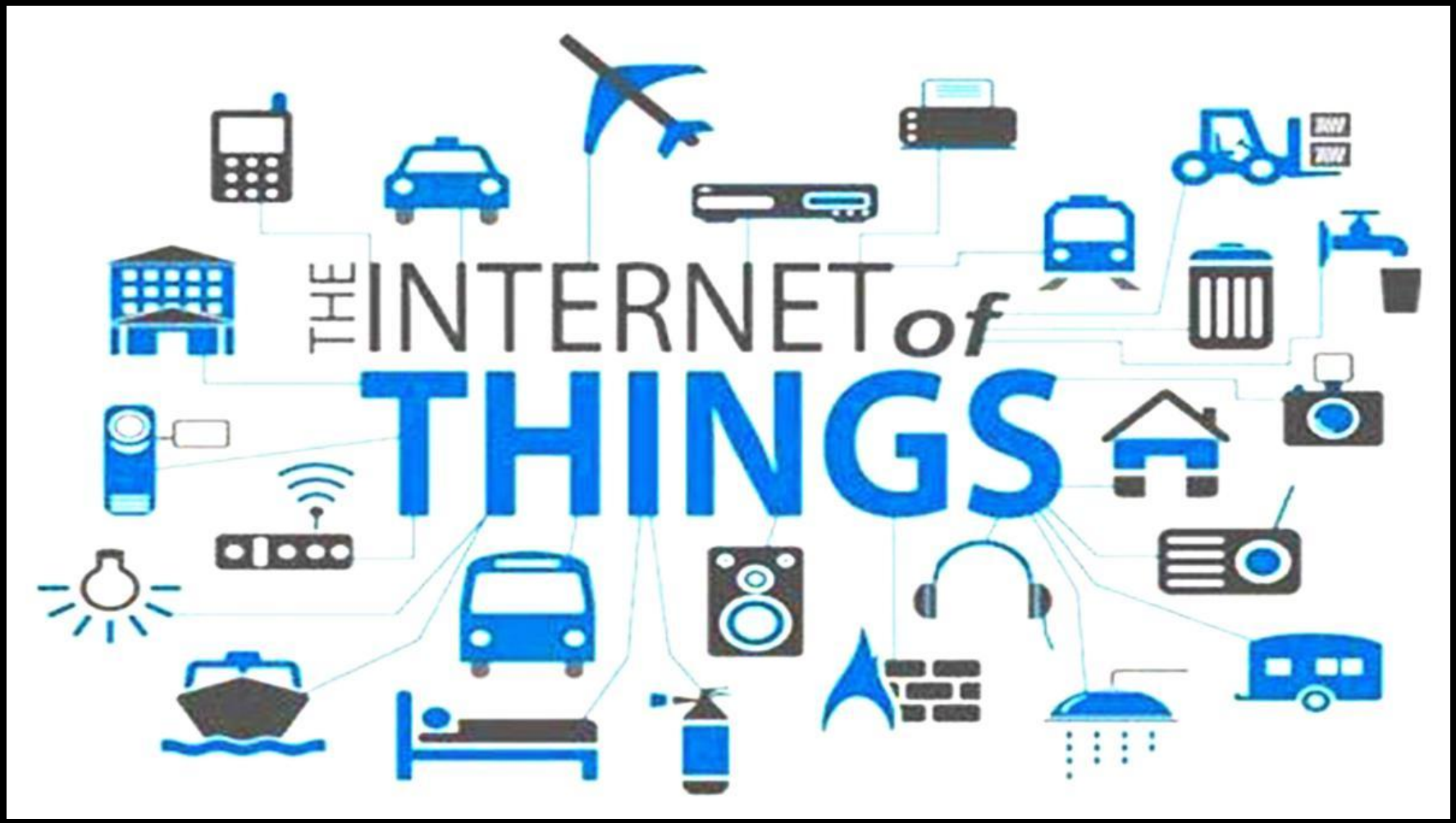
Untreated wound

UVC-treated wound

Yara bandajı içine konulan LED > ilaç Ø > enfeksiyon Ø

IoT
Nesnelerin interneti

- Internet üzerinden
- diğer cihaz ve sistemlerle veri bağlantısı ve paylaşımı
- sensörler, yazılımlar ve diğer teknolojilerle gömülü olan fiziksel nesnelerin ağı


THE INTERNET of
THINGS

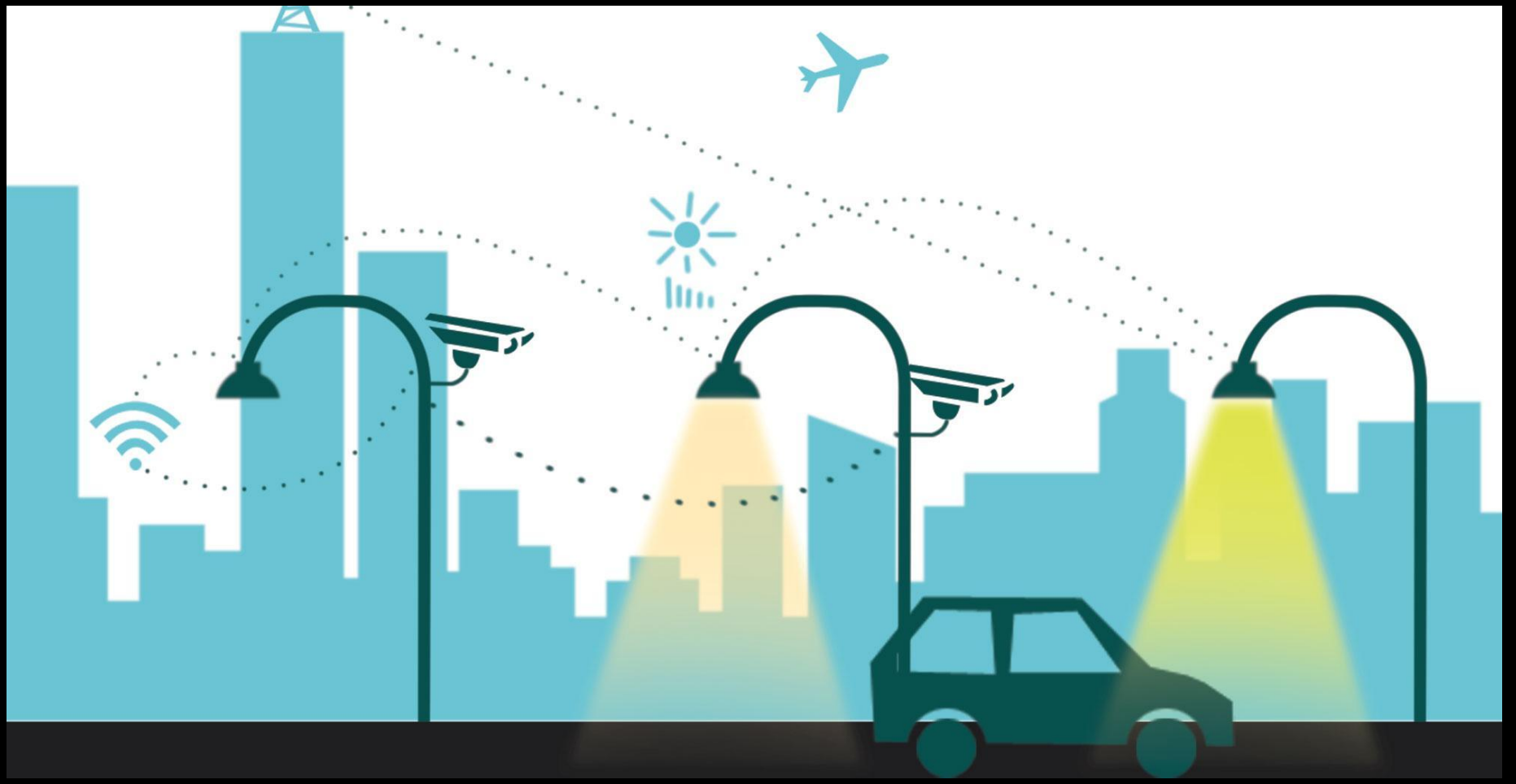
IoT
Nesnelerin interneti

Smart city
"Akıllı Şehirler"

- Geleceğin şehir merkezidir

- Güvenli
- Çevre dostu
- Verimli

- Tüm yapılar, güç, su, ulaşım vb. senkronize



IoE (Cisco)
Herşeyin interneti

- Sadece nesneler değil
- + insanlar, süreçler ve veriler…

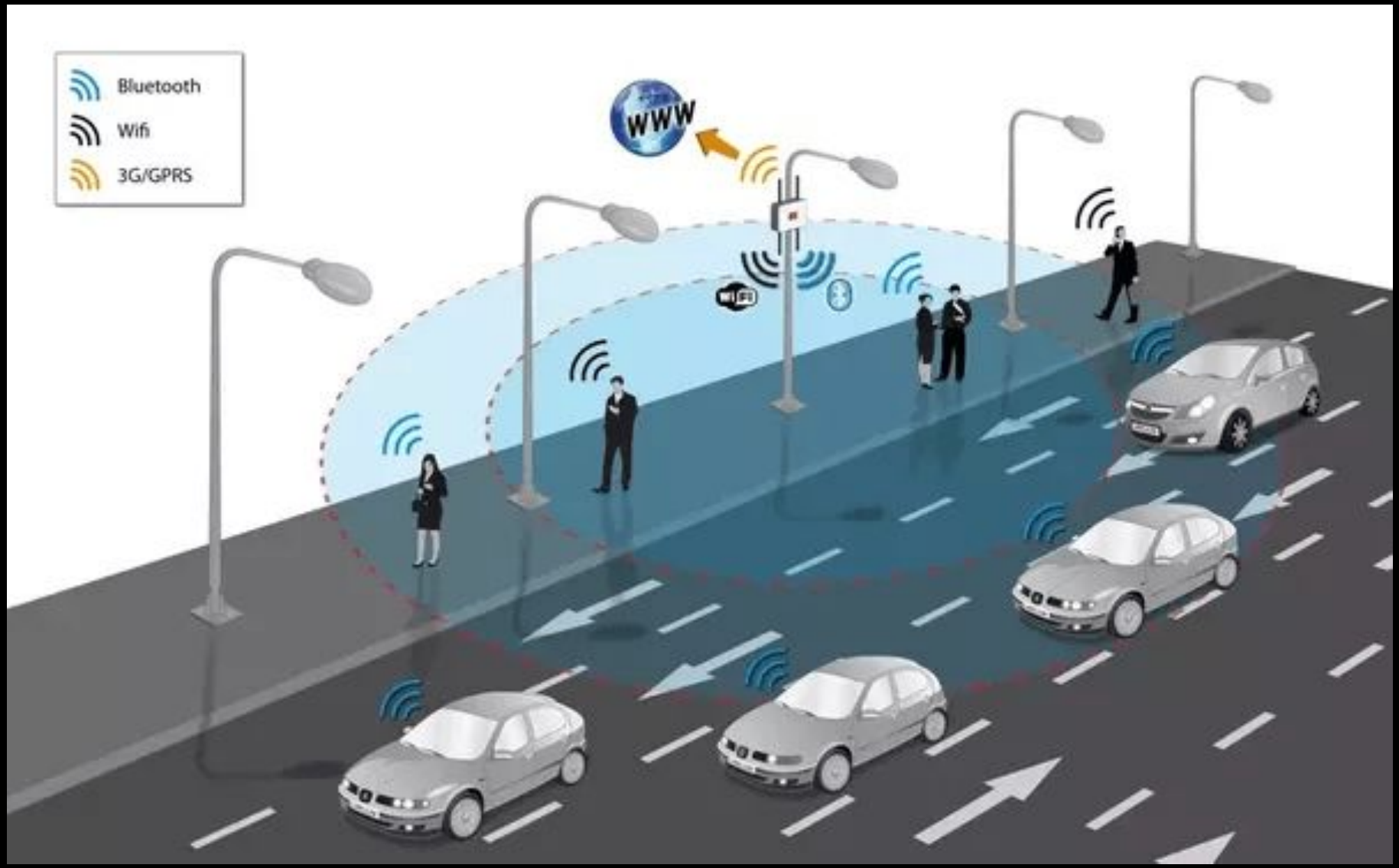
IoE
Herşeyin interneti

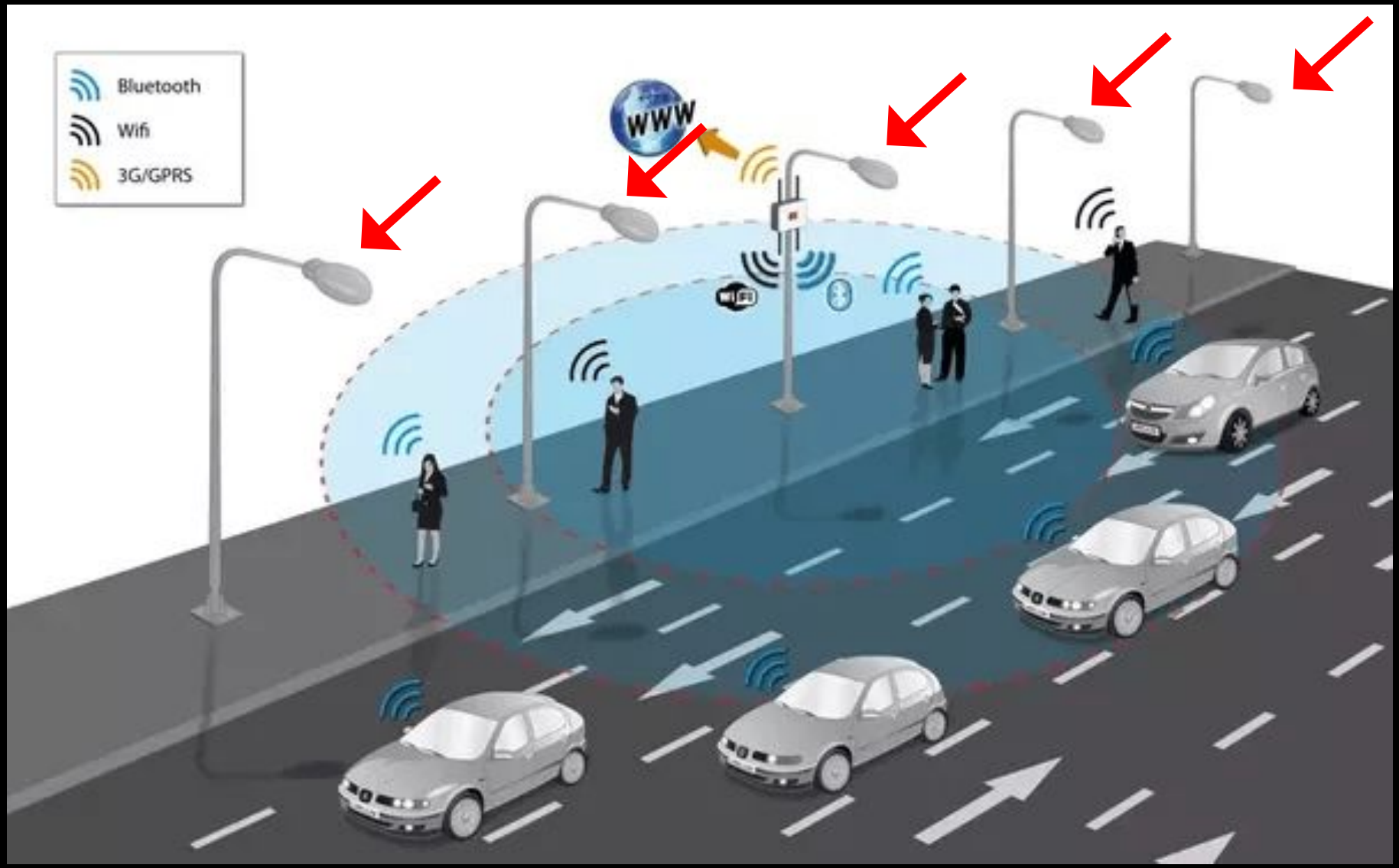
- Sadece nesneler değil
- + insanlar, süreçler ve veriler…

- Tüm bu unsurların birbiriyle bağlantılı olduğu bir ekosistem

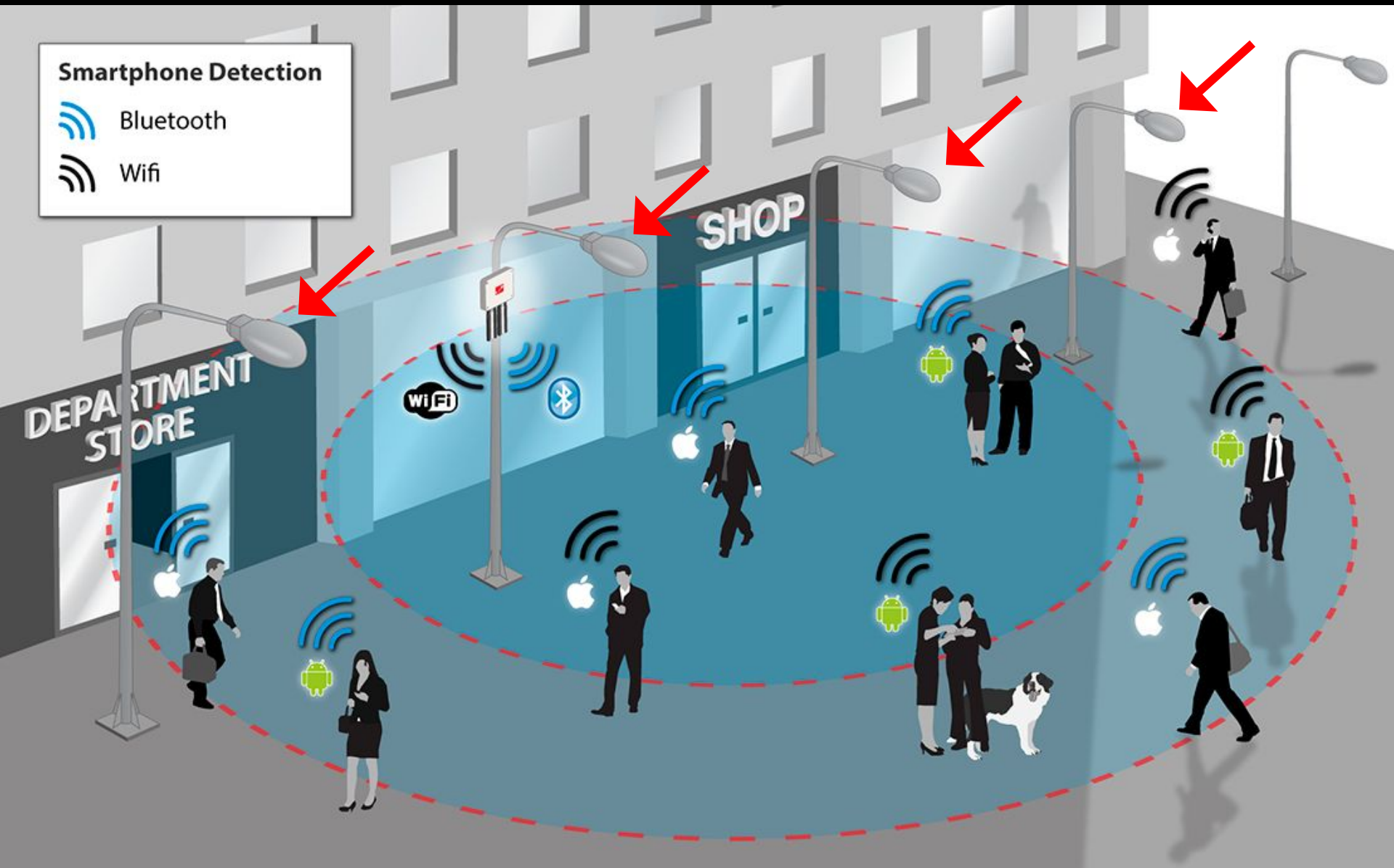
Li-Fi (Light Fidelity)

- Kablosuz: Veri aktarımı için LED'ler.
- Görünür ışık iletişimi (VLC) teknolojisi.


Bluetooth
Wifi
3G/GPRS
WWW


Bluetooth
Wifi
3G/GPRS
WWW


Smartphone Detection
Bluetooth
Wifi
SHOP
DEPARTMENT STORE
WiFi

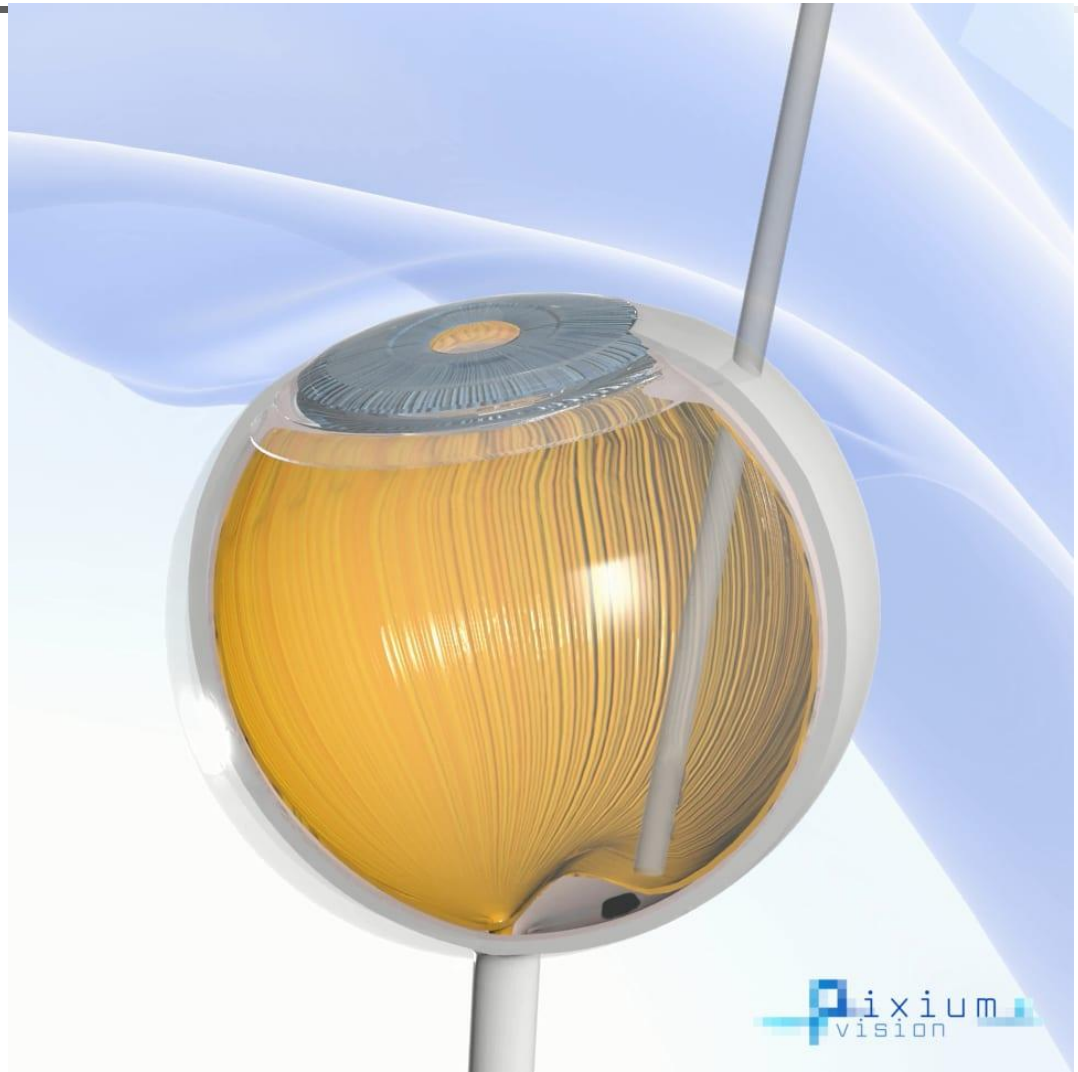

Smartphone Detection
Bluetooth
Wifi
SHOP
DEPARTMENT STORE
WiFi

Li-Fi DATA TRANSMISSION PERSPECTIVE IN HUMAN ARTIFICIAL VISION IN BLIND PATIENTS

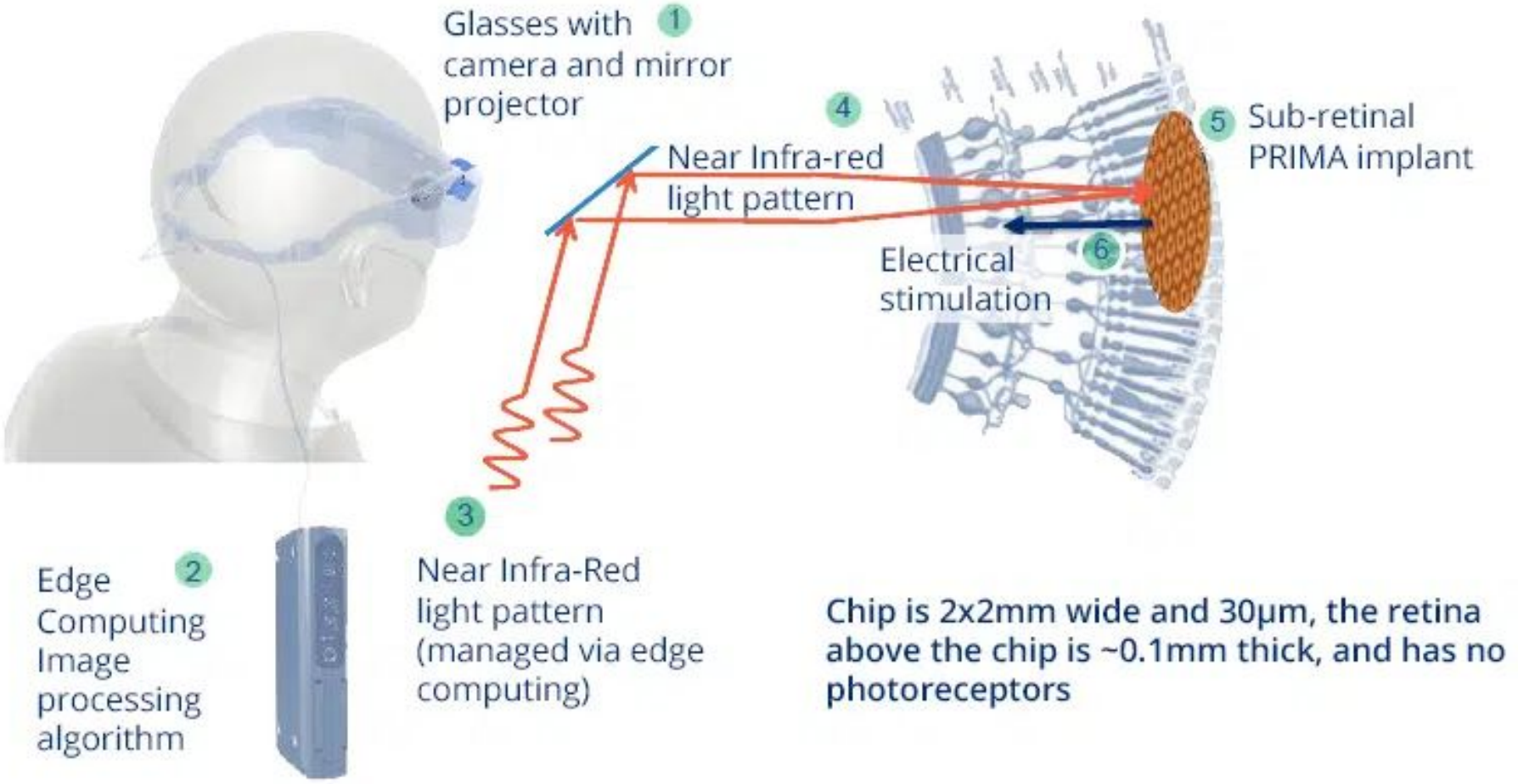
Dr. K. Hilmi OR, PhD, MSc , PA, FICO, FEBO, AFIAP
Ophthalmic Surgeon
Hamburg/Germany & Istanbul/Turkey

Fellow of European Board of Ophthalmology
Fellow of International Council of Ophthalmology
PhD in Forensic Medicine
Master in ”Vision, Artificial Vision and Low Vision Rehabilitation”
”Profiency in Arts ” in Photography (Equivalent to PhD)
Artist of International Federation of Photographic Art
Associate Degree in ”Media and Communication”
Associate Degree in Web Design and Coding
Individual Member of ATMK ”Turkish National Committee on Illumination”
Individual Member of DNK-CIE ”German National Committee on Illumination”
Individual Member of AIC ”International Colour Association”
Student of Bachelor in Visual Communication Design

Pixium
Prima System



Pixium
Prima System



Pixium
Prima System

- Boyut: 2x2mm boyut
- 30 µm kalınlık (insan saçının 1/3'ü)

Pixium
Prima System

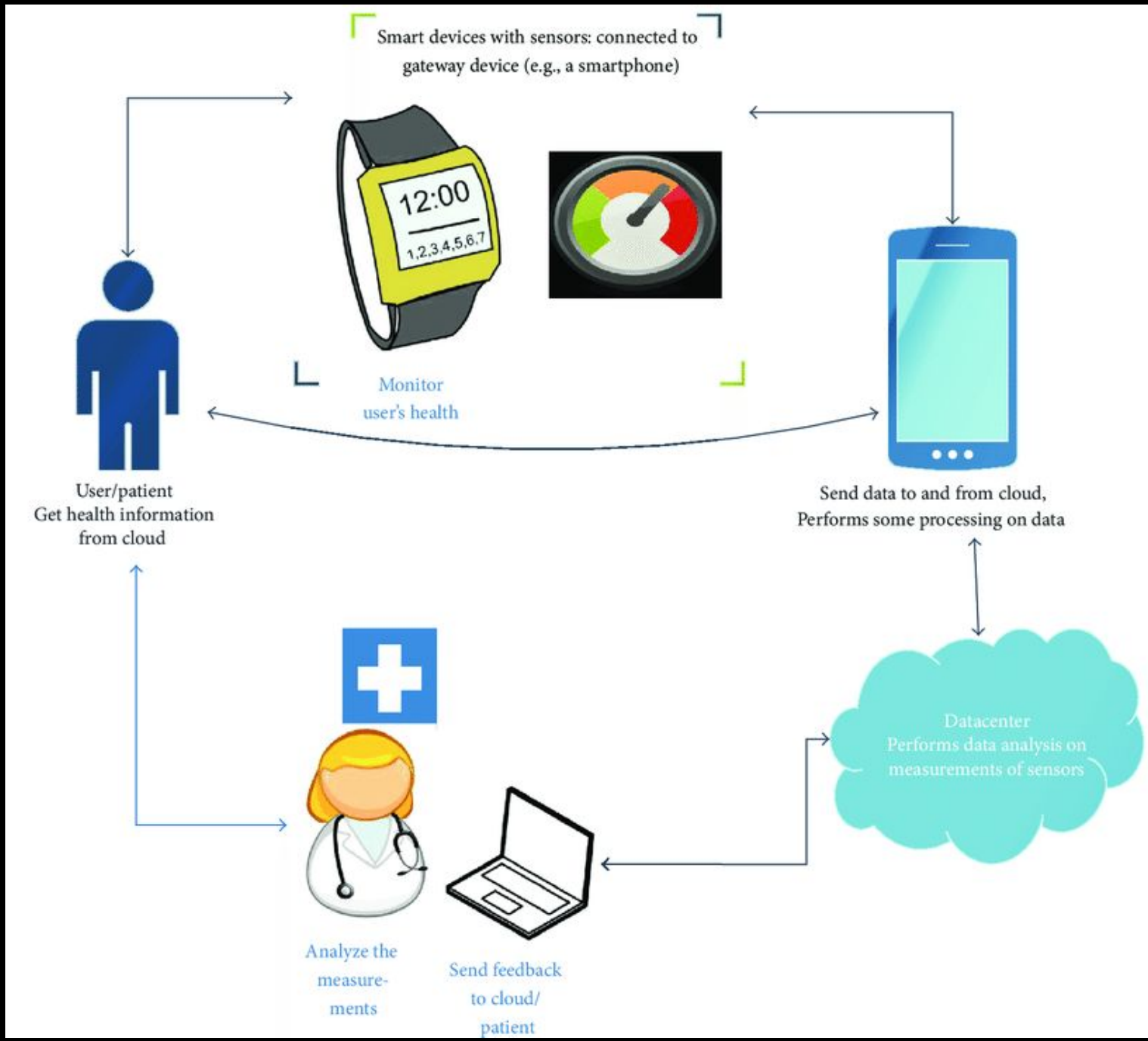
- Boyut: 2x2mm boyut
- 30 µm kalınlık (insan saçının 1/3'ü)

- Minik "güneş paneli"
- >darbeli yakın kızılötesi ışıkla çalışır
- >minyatür dijital projector
- >implante edilen kişinin giydiği gözlük çiftine entegre

Smart Health

What is Smart Health?

- Provision of health-related services using a network of context-aware intelligent agents


Smart devices with sensors: connected to gateway device (e.g., a smartphone)
12:00
1,2,3,4,5,6,7
Monitor user's health
User/patient
Get health information from cloud
Send data to and from cloud,
Performs some processing on data
Datacenter
Performs data analysis on measurements of sensors
Analyze the measure-ments
Send feedback to cloud/ patient

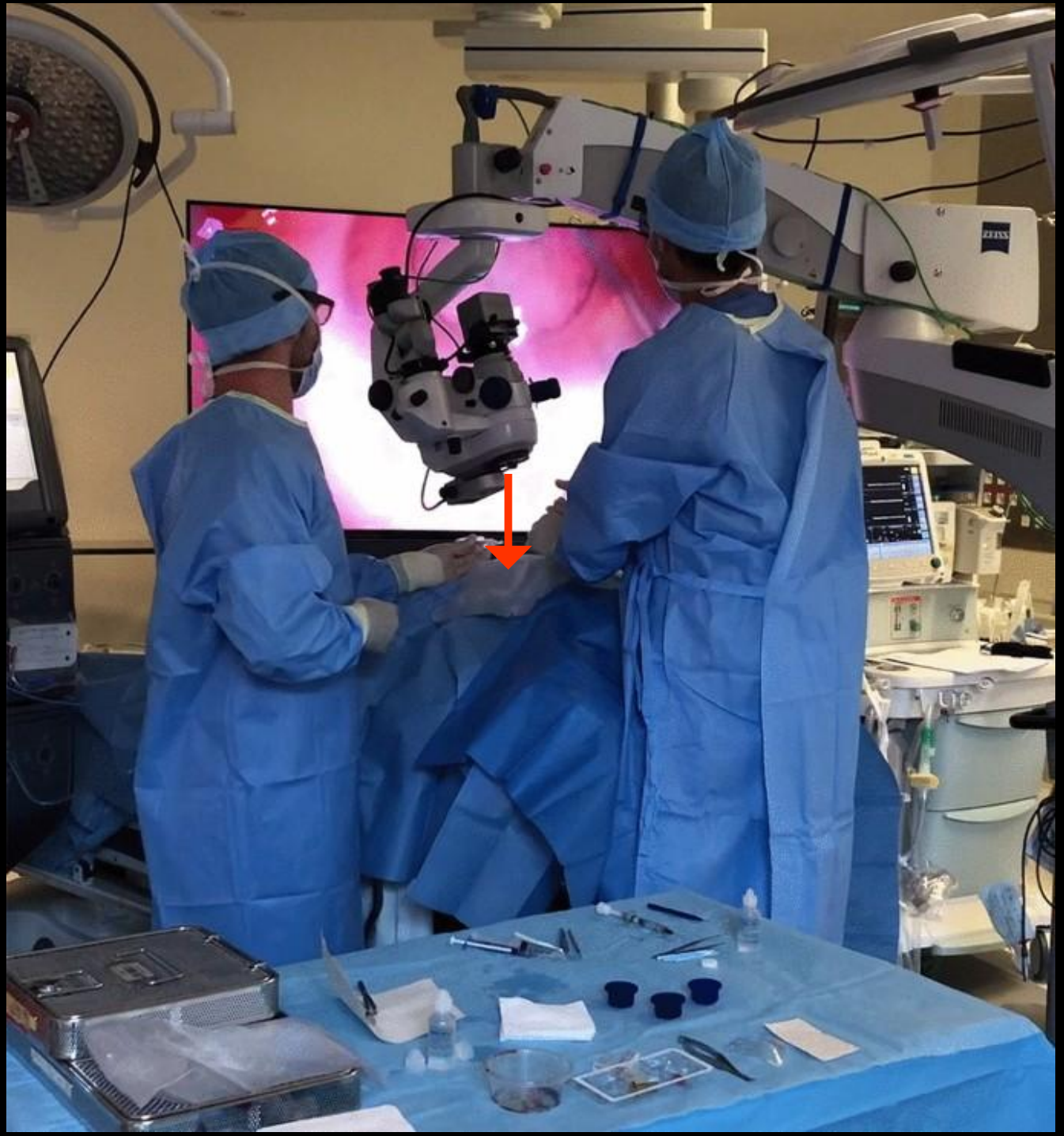
Sanal gerceklik

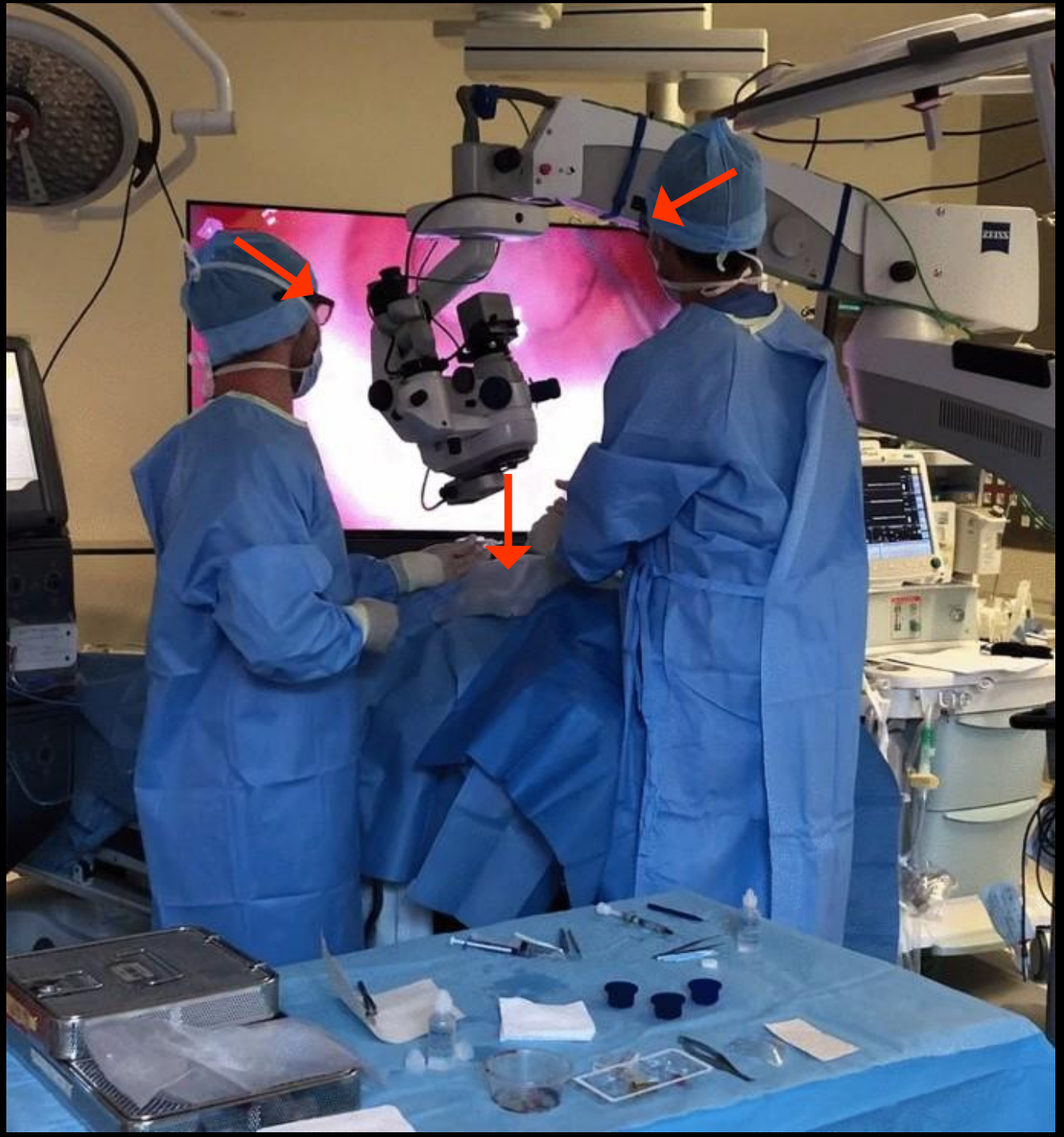
Aydınlatma

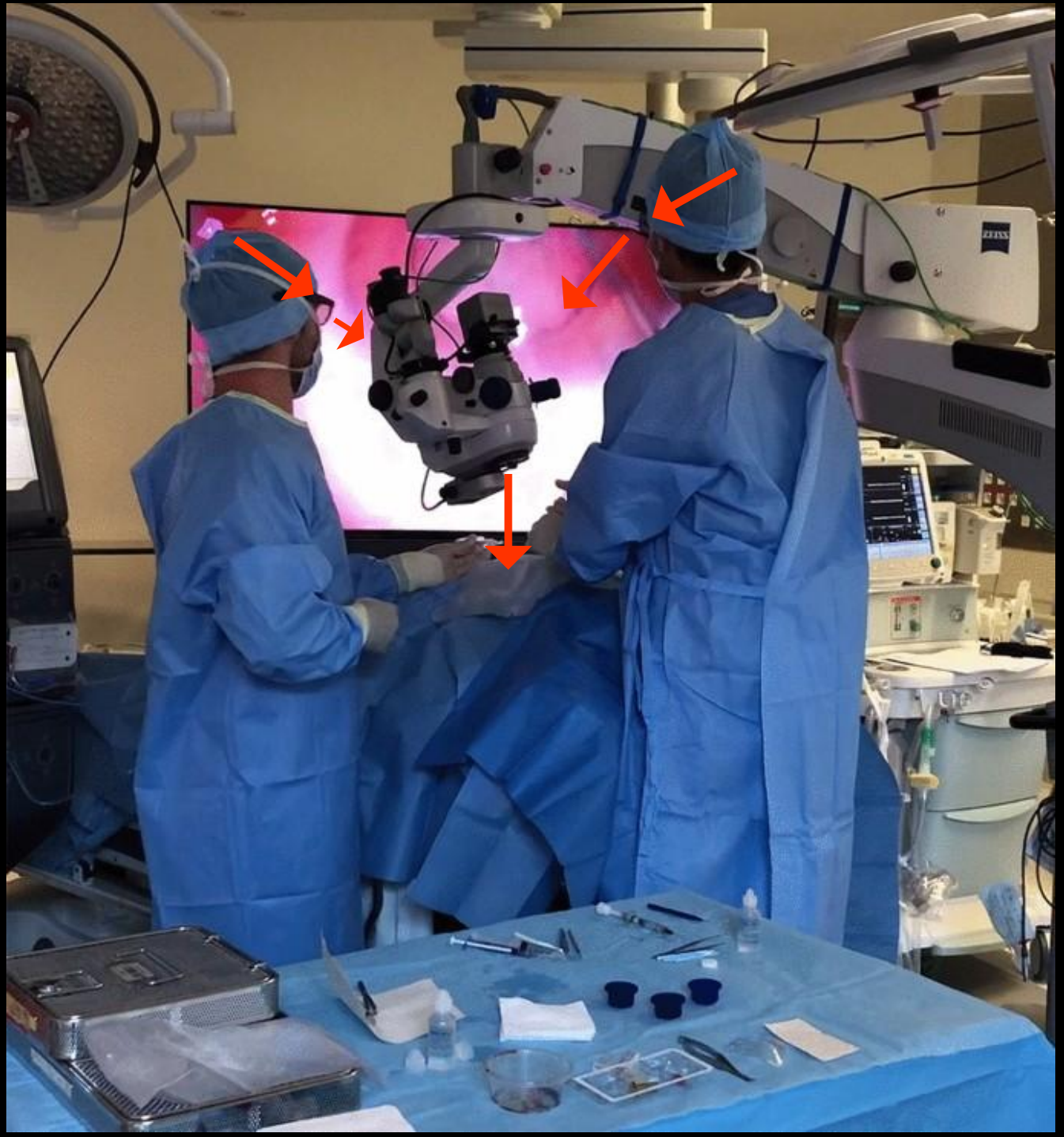
- Cerrahi…

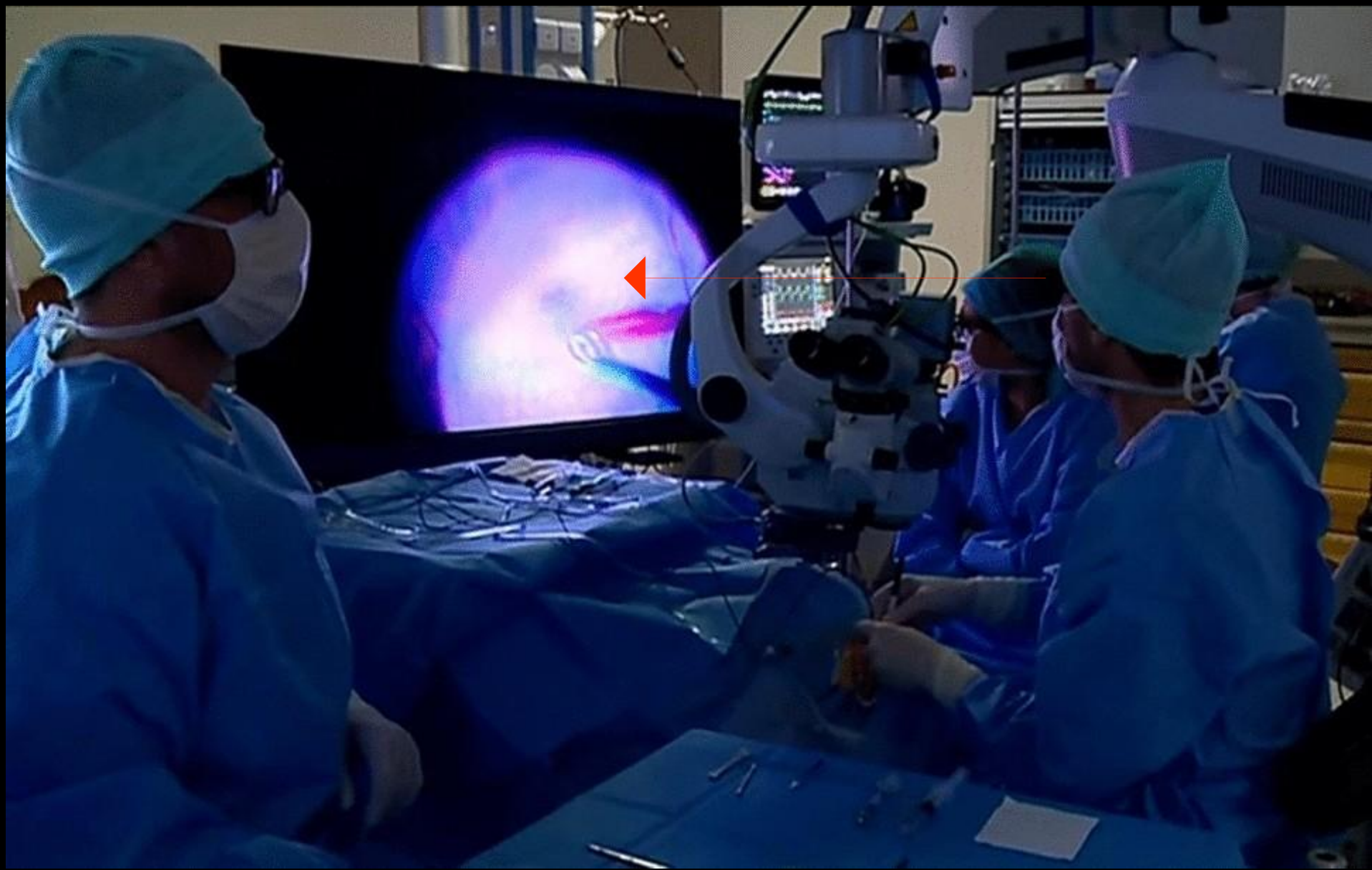
- Ameliyathane
- Mikroskop
- Optik olarak şeffaf dokulara sahip organ: Göz ameliyatları

3D cerrahi görüntüleme sistemleri

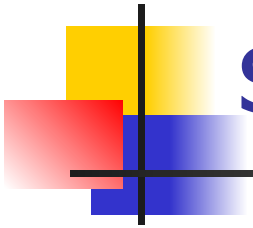








3D cerrahi görüntüleme sistemleri

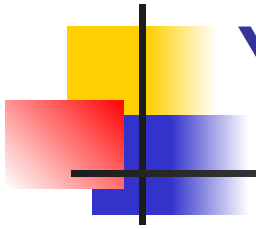


- Ameliyat olan hastanın
- &
- ameliyatı yapan cerrahın
- gözüne daha az ışık

3D cerrahi görüntüleme sistemleri

- Ameliyat olan hastanın
- &
- ameliyatı yapan cerrahın
- gözüne daha az ışık

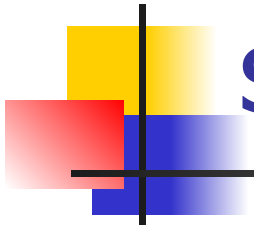
- Fototoksisite ↓



Yapay zeka

- 3d ameliyat görüntüleme sistemlerinde
- Sanal renk filtreleri

3D cerrahi görüntüleme sistemleri

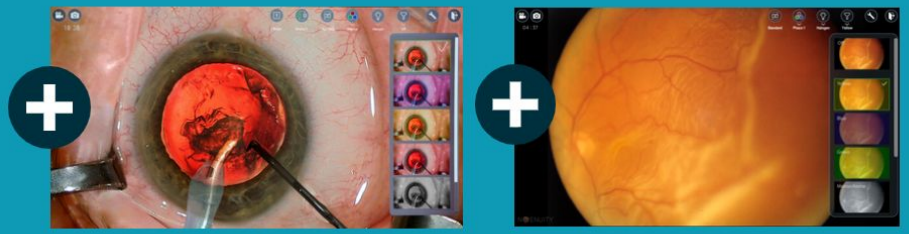


- Dijital / sanal filtreler

- Renk filtreleri
- Polarize filtreler
- Görüntü düzeltme
- Renk sıcaklığı
- …

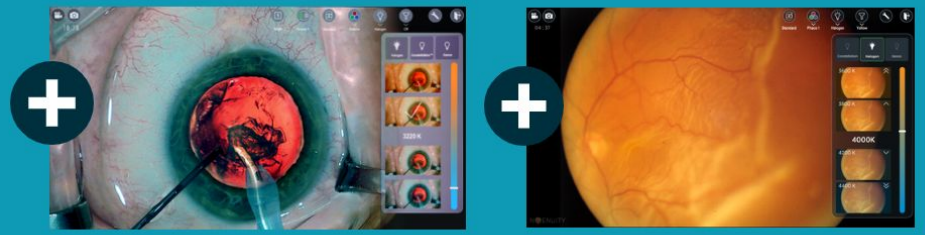
COLOR PROFILES

Personalized color profiles provide more flexibility to customize your approach for each patient. [2]



LIGHT TEMPERATURE PROFILES

Easy-to-use thumbnails allow you to customize the image during the surgical procedure.[3]



LESS MICROSCOPE LIGHT

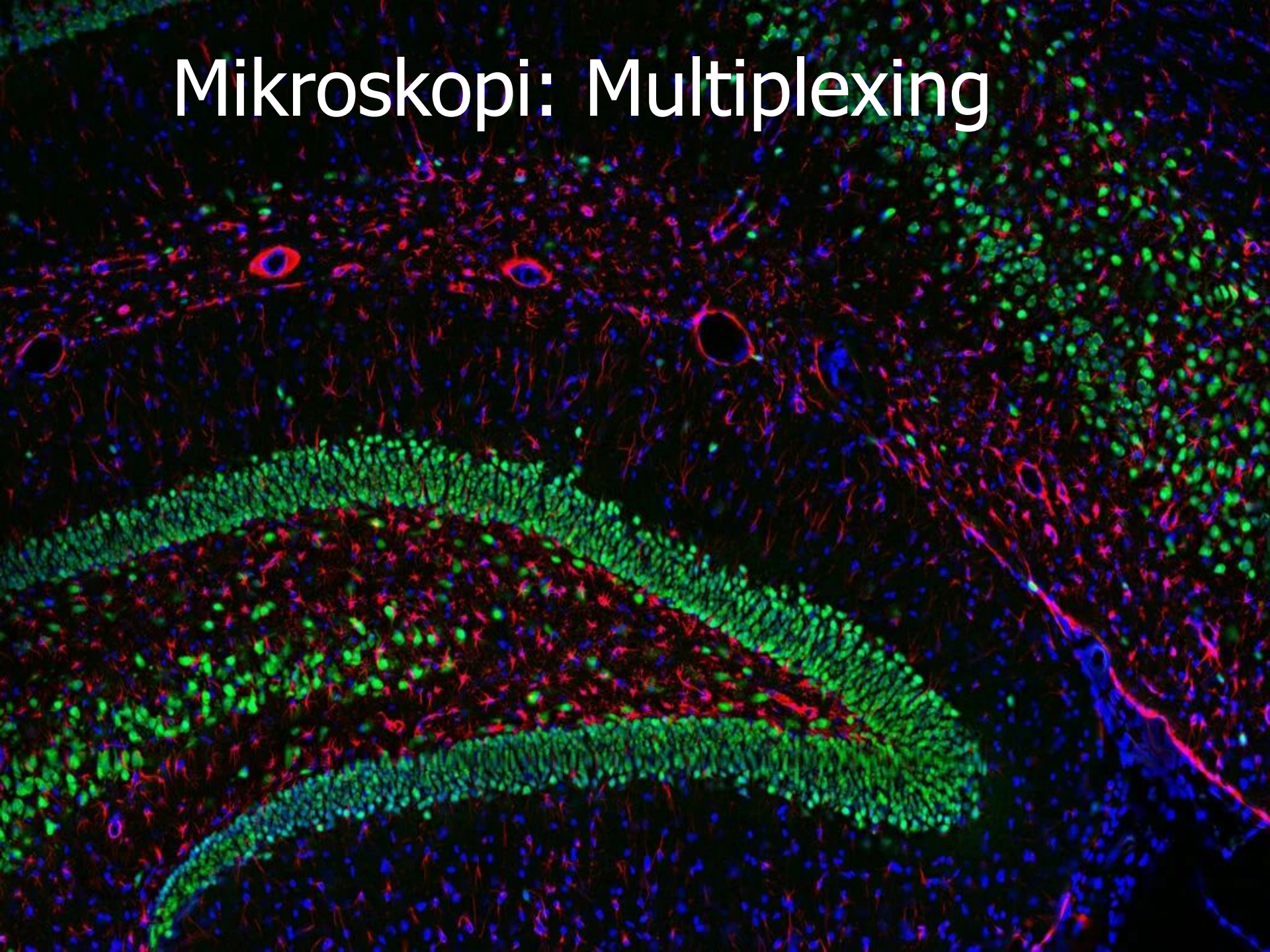
Digital image processing provides you with the ability to operate under low lighting conditions, potentially reducing phototoxicity.[4]

CUSTOM IMAGE PROFILE

Allows you to link CONSTELLATION®Vision System procedure steps with your preferred image mode for greater efficiency and enhanced visualization.

Yapay zeka:
Mikroskopta hücre görüntüleme

Mikroskopi: Multiplexing




Mikroskopi: Multiplexing
Eşzamanlı çoklu flöresan boyalar

Fotoakustik görüntüleme

Steinberg I, Huland DM, Vermesh O, Frostig HE, Tummers WS, Gambhir SS.
Photoacoustic clinical imaging.
Photoacoustics. 2019 Jun 8;14:77-98.
doi: 10.1016/j.pacs.2019.05.001.

- Dokudaki optik soğurucuların akustik detektörler (ışık girişi - ses çıkışı) tarafından görüntülenmesi

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- Dokudaki optik soğurucuların akustik detektörler (ışık girişi - ses çıkışı) tarafından görüntülenmesi

- Yüksek çözünürlük
- yeterli görüntüleme derinliği
- çeşitli endojen ve eksojen kontrast
- iyonlaştırıcı radyasyon içermemesi

- > Klinik kullanım

Steinberg I, Huland DM, Vermesh O, Frostig HE, Tummers WS, Gambhir SS.
Photoacoustic clinical imaging.
Photoacoustics. 2019 Jun 8;14:77-98.
doi: 10.1016/j.pacs.2019.05.001.

- Beyin fonksiyonel görüntüleme
- meme kanseri taraması
- sedef hastalığı ve cilt lezyonlarının teşhisi
- biyopsi ve cerrahi rehberliği
- üreme ve ürolojik sistemlerde tümör tedavilerinin rehberliği
- tümör görüntüleme

Steinberg I, Huland DM, Vermesh O, Frostig HE, Tummers WS, Gambhir SS.
Photoacoustic clinical imaging.
Photoacoustics. 2019 Jun 8;14:77-98.
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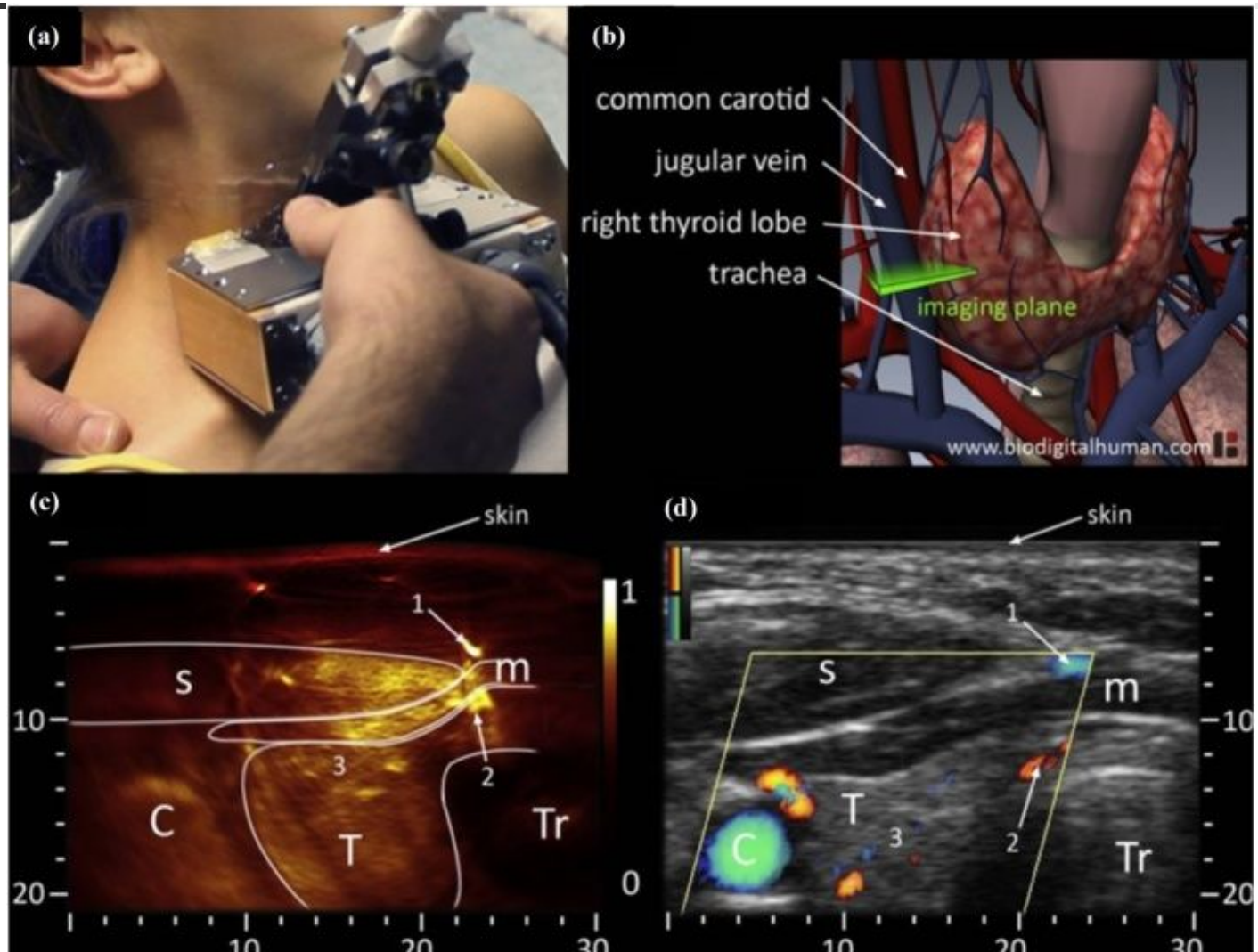

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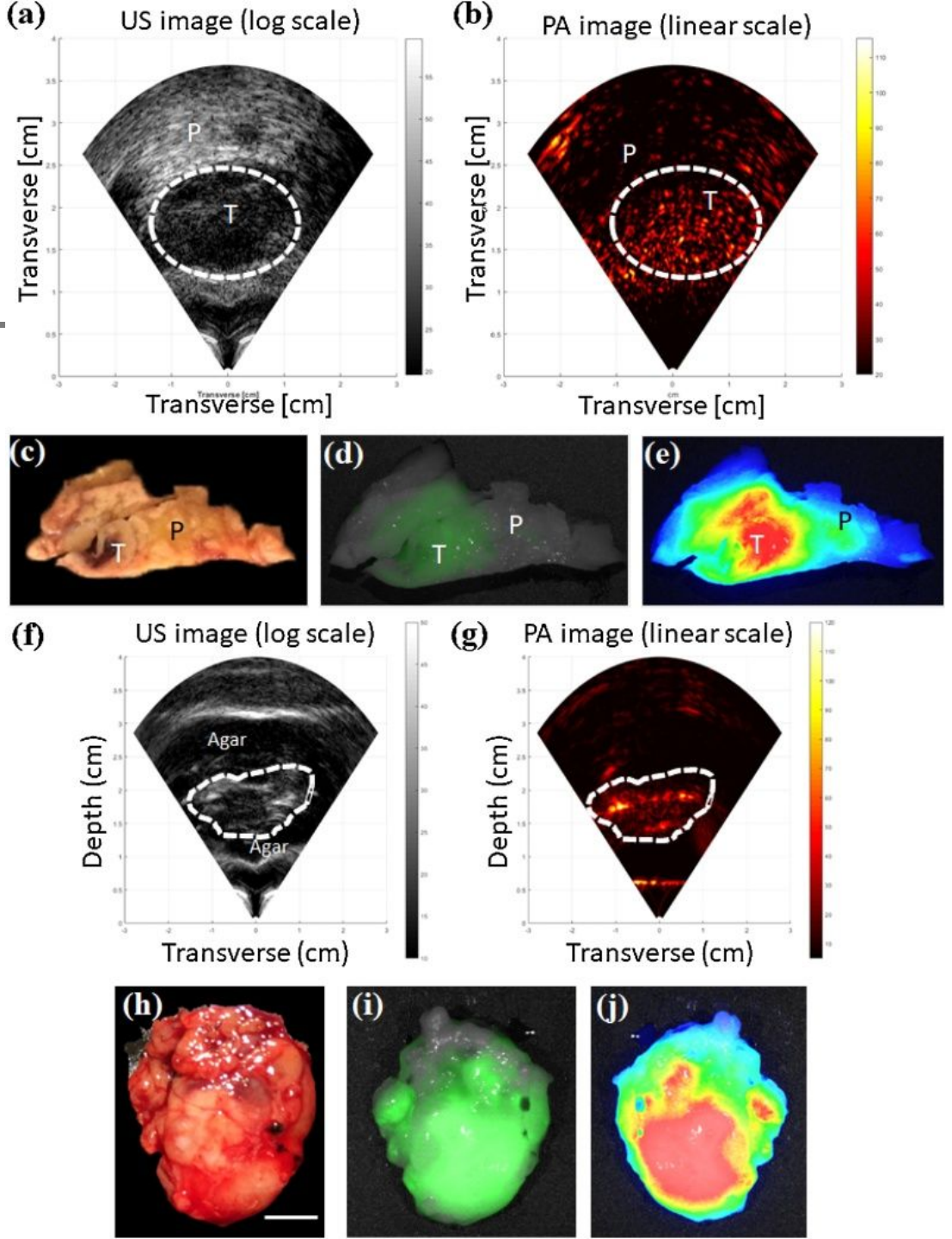
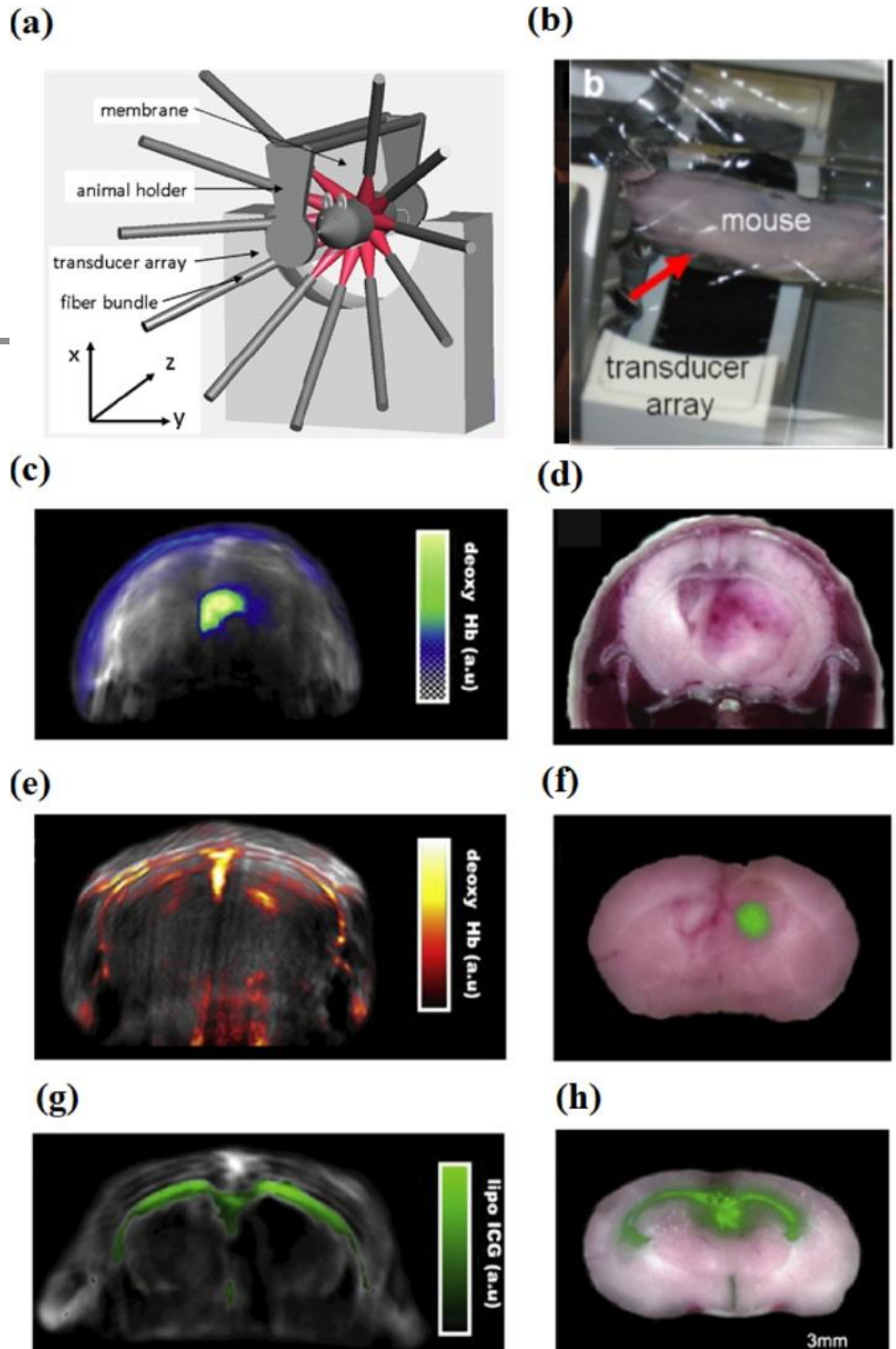
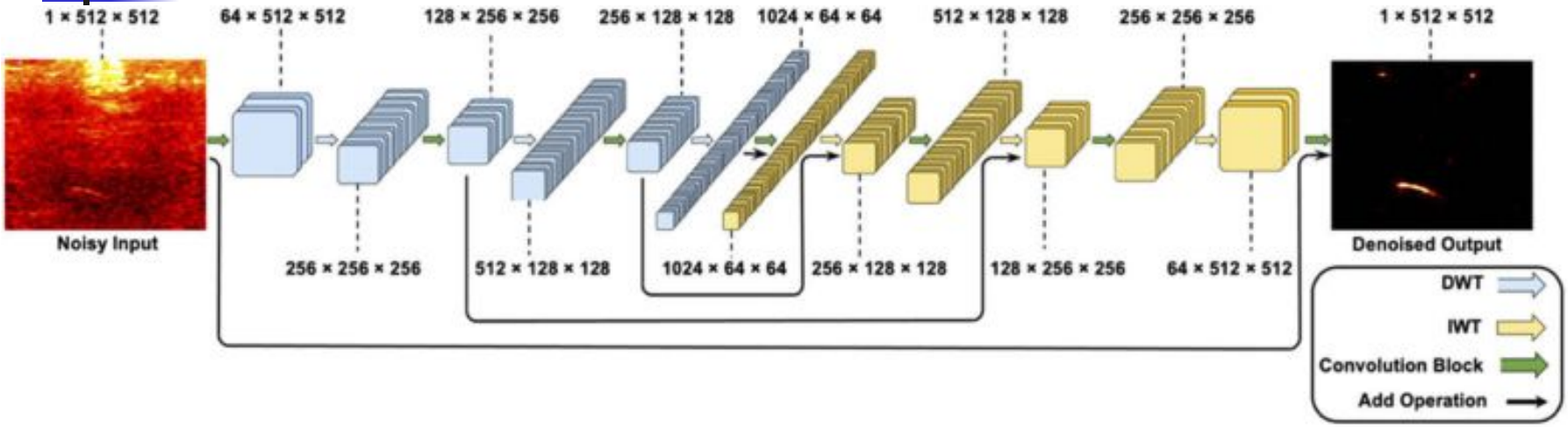


- Steinberg I, Huland DM, Vermesh O, Frostig HE, Tummers WS, Gambhir SS. Photoacoustic clinical imaging. Photoacoustics. 2019 Jun 8;14:77-98. doi: 10.1016/j.pacs.2019.05.001.



Hariri A, Alipour K, Mantri Y, Schulze JP, Jokerst JV.
Deep learning improves contrast in low-fluence photoacoustic imaging.
Biomed Opt Express. 2020 May 29;11(6):3360-3373.
doi: 10.1364/BOE.395683. PMID: 32637260; PMCID: PMC7316023.



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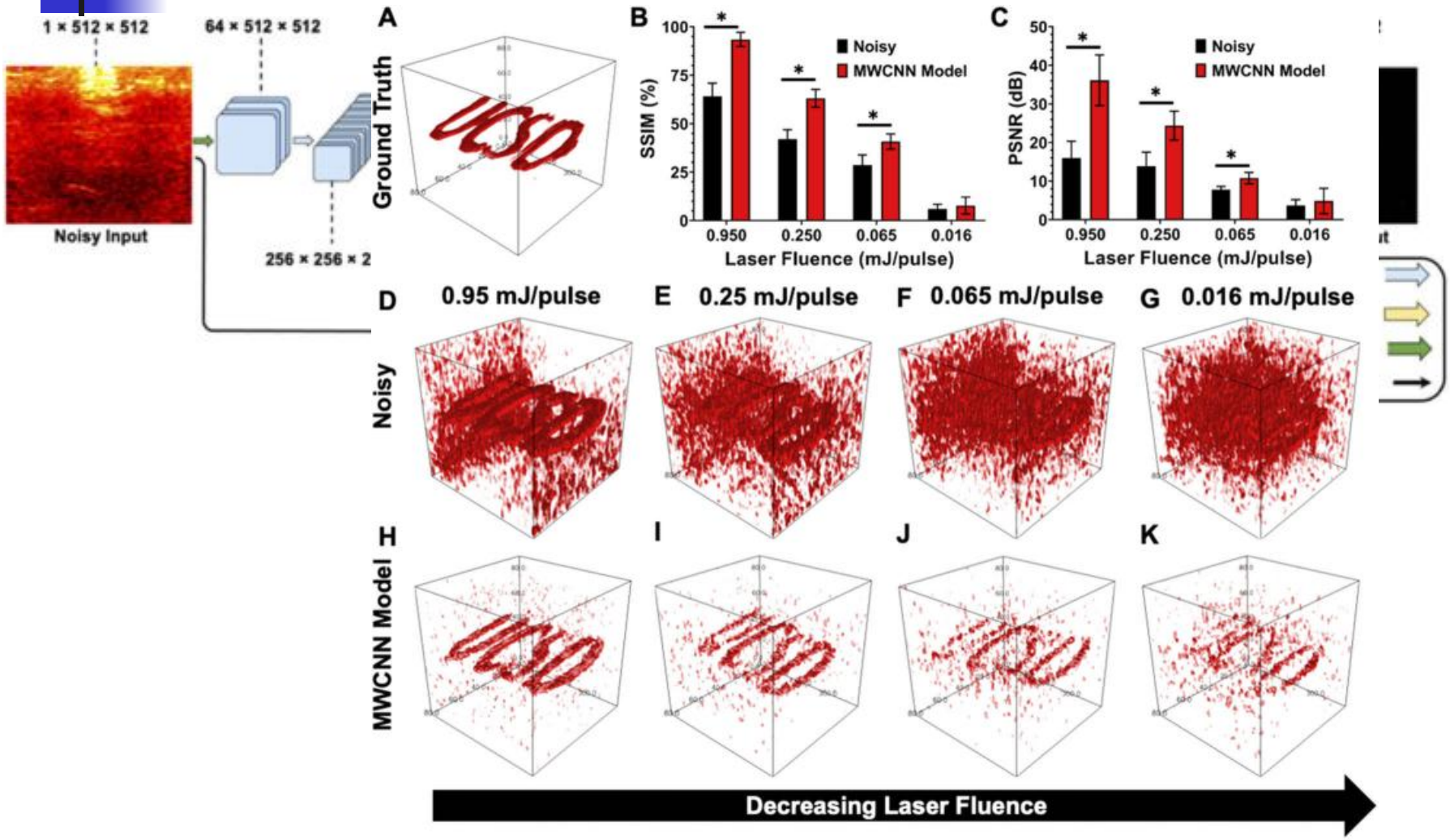


Robotic control

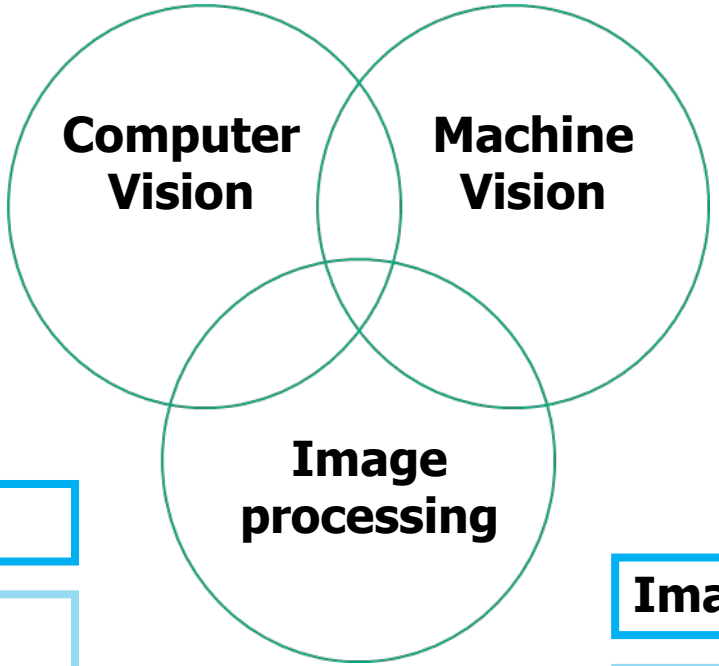
Robotic vision

Artificial intelligence

Computer intelligence

Signal processing

Non lineer
Multivariate



Machine learning

Perceptual vision

Physics

Optics

Mathematics

Statistics
Geometry
Optimisation

Imaging

Fast cameras

Neurobiology

Biologic vision

Robotic control

Robotic vision

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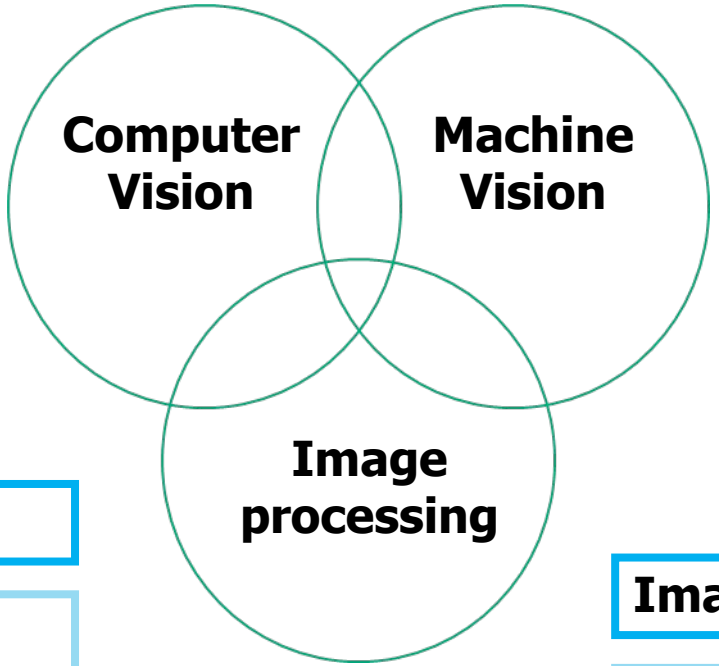

Machine learning

Perceptual vision

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Fast cameras

Neurobiology

Biologic vision

Bu konudaki en önemli nokta

- İnsan görmesi
- versus
- Makine görmesi / Bilgisayar görmesi

Önemli nokta

- İnsan görmesi
- versus
- Makine görmesi / Bilgisayar görmesi

- Aydınlatma ihtiyaçları farklı…
- İnsan görmesi için gerekli olan aydınlatma makine görmesini bozabilir.

Robotic control

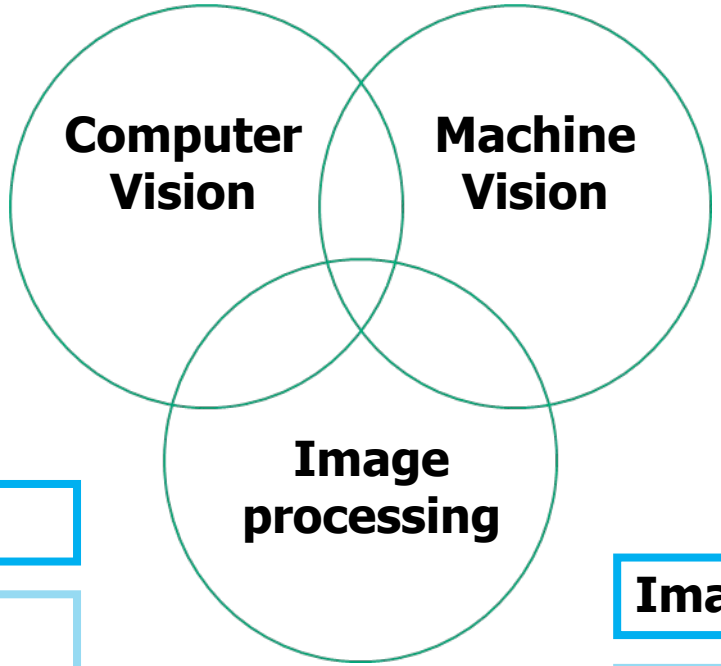
Robotic vision

Artificial intelligence

Computer intelligence

Signal processing

Non lineer
Multivariate



Machine learning

Perceptual vision

Physics

Optics

Mathematics

Statistics
Geometry
Optimisation

Imaging

Fast cameras

Neurobiology

Biologic vision

Aydınlatmada Kullanılan Bazı Nanoteknolojik Materyaller

- Karbon Nanotüpler (Carbon Nanotubes - CNTs
- Nano Kuantum Noktaları (Quantum Dots - QDs)
- Grafen
- Nano Yapılı Fosforlar

Yapay Zeka ve Aydınlatma

- Enerji Verimliliği
- Akıllı Aydınlatma Kontrolü
- Duygu Aydınlatması
- Güvenlik ve Gözetim
- Veri Analizi ve Optimizasyon

Nanoteknoloji ve Aydınlatma

- Verimli Aydınlatma
- Renk Kontrolü ve Aydınlatma Tasarımı
- Esnek ve Şeffaf Aydınlatma
- Daha İyi Dağılım ve Işık Yönlendirme

Aydınlatmada Kullanılan Nanoteknolojiler

- Nanokristal Bazlı LED'ler
- Nanodokulu Kaplamalar
- Nanoyapılı Fosforlar
- Nano Yapılı Kaplamalar ve Filtreler
- Esnek ve Şeffaf Aydınlatma Malzemeleri

Aydınlatmada Kullanılan Metamateryaller

- Plazmonik Metamateryaller
- Fotoniğe Dayalı Metamateryaller
- Nanoanteni Metamateryaller
- Akustik Metamateryaller
- Fotoakustik

Aydınlatma için elektrik enerjisinin kablosuz aktarımı

- Manyetik Rezonans
- Radyo Frekansı (RF) İletişimi
- Mikrodalga İletişimi
- Elektromanyetik indüksiyon

Elektromanyetik indüksiyon

- Kablosuz cep telefonu şarj cihazları
- Yakın mesafelerde enerji transferi

Optogenetik

- Yalnızca ışığı kullanarak
- sinir hücrelerini & kasları
- «açıp kapatmak»

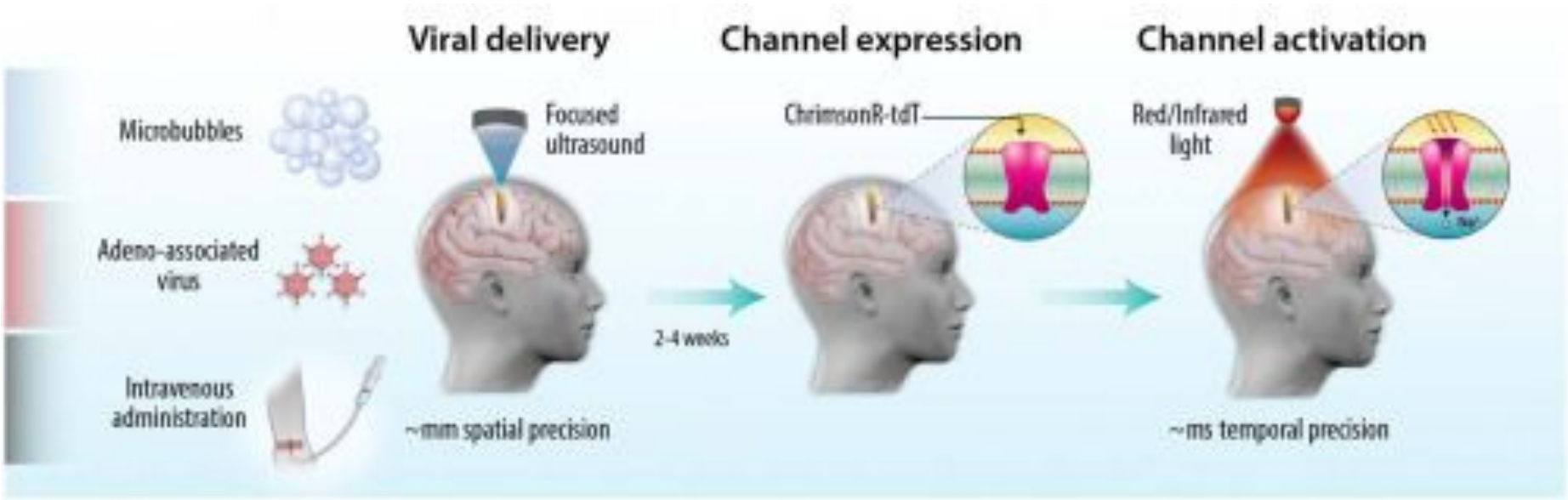
- >>>
- Tıbbi tedaviler

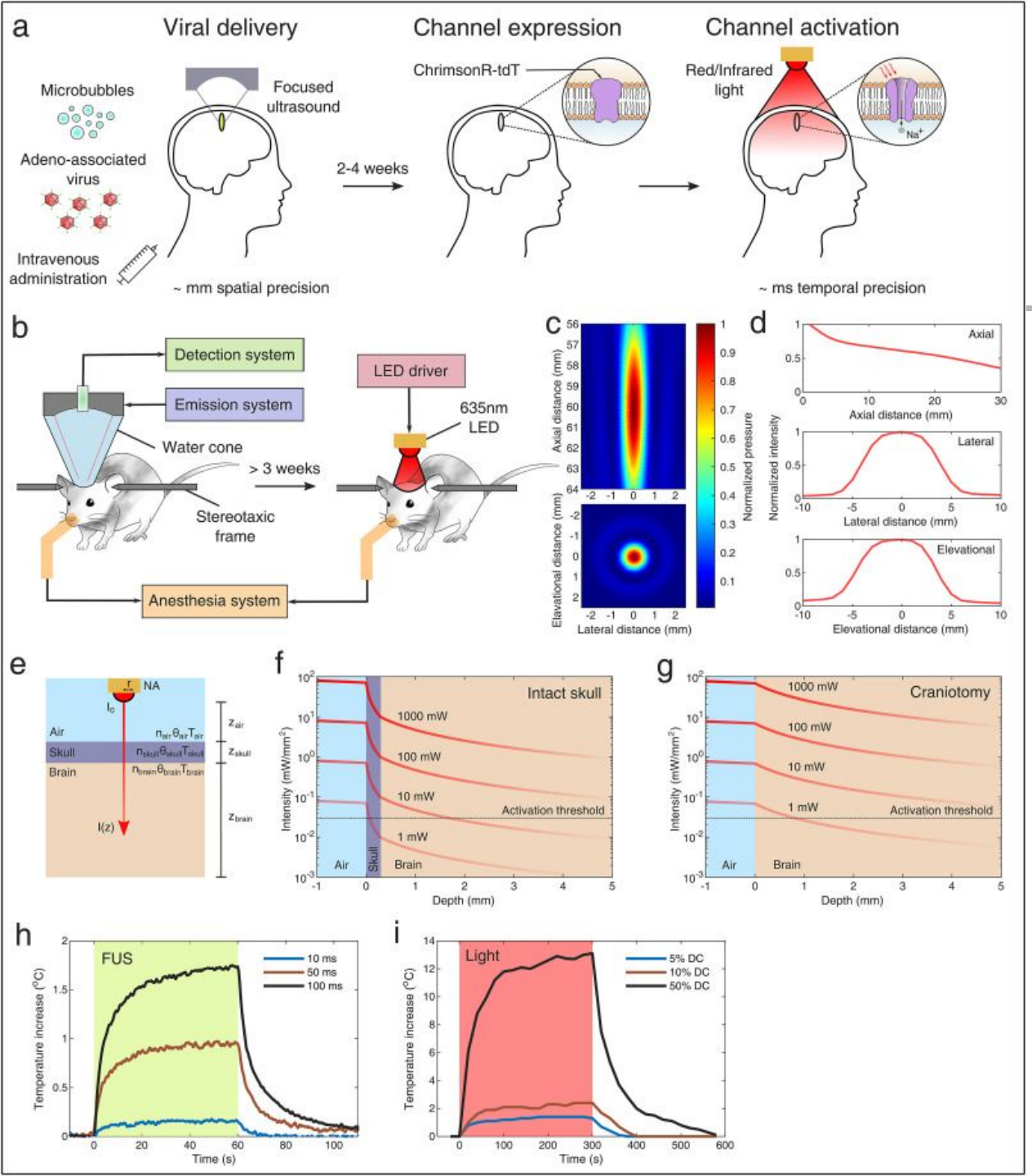
Optogenetik

- Genetiği değiştirilmiş hücrelerin ışık kullanılarak kontrolü.

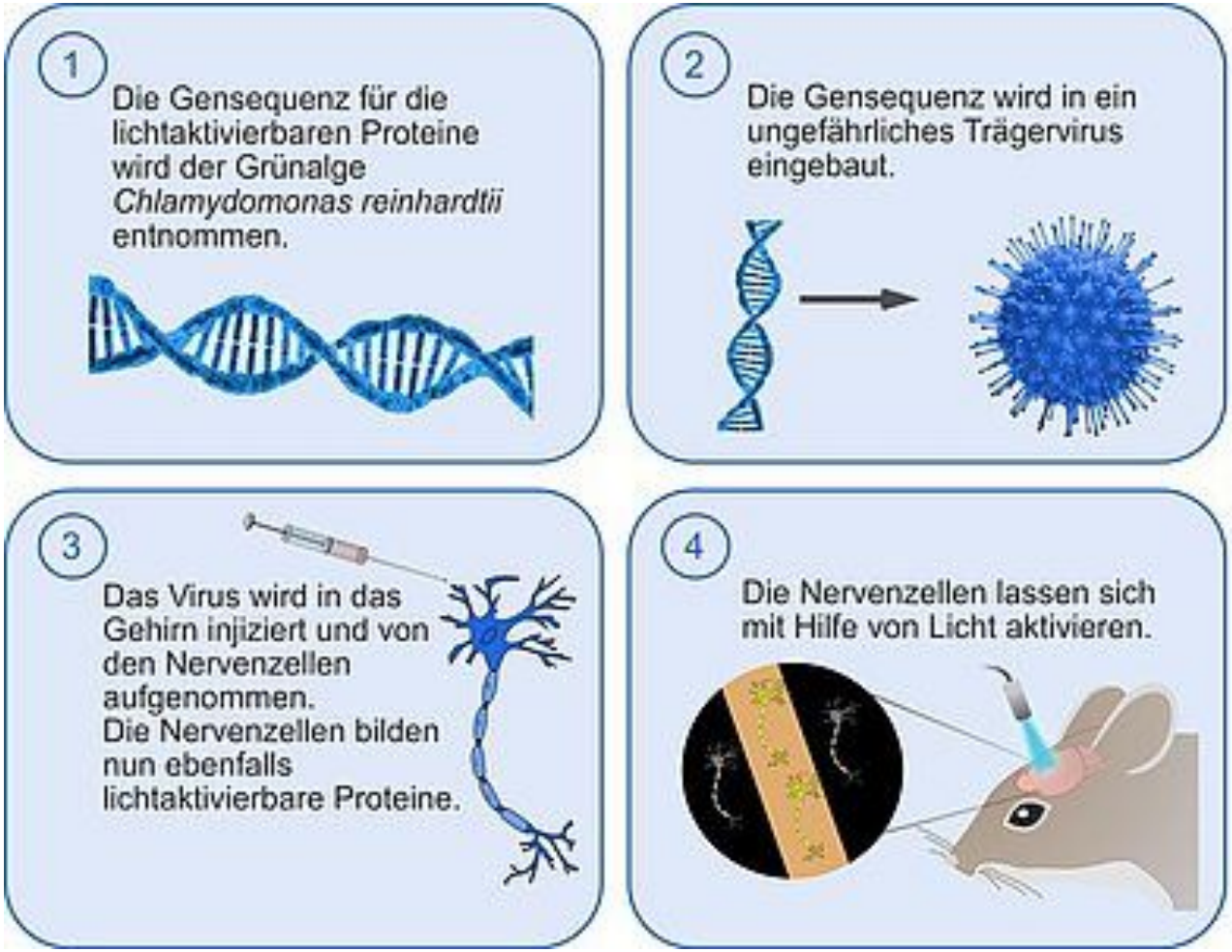
- Bakteriyorodopsin / kanalrodopsin:
- Sinir hücreleri vb. içine yerleştirilmiş
- ışıkla aktive edilebilen membran proteinleri

Pouliopoulos AN, Murillo MF, Noel RL, Batts AJ, Ji R, Kwon N, Yu H, Tong CK, Gelinas JN, Araghy DK, Hussaini SA, Konofagou EE.
Non-invasive optogenetics with ultrasound-mediated gene delivery and red-light excitation.
Brain Stimul. 2022 Jul-Aug;15(4):927-941. doi: 10.1016/j.brs.2022.06.007.
Epub 2022 Jun 16. PMID: 35718324; PMCID: PMC9379392.




a
Viral delivery
Channel expression
Channel activation
Microbubbles
Adeno-associated virus
Intravenous administration
Focused ultrasound
2-4 weeks
ChrimsonR-tdT
Red/Infrared light
~ mm spatial precision
~ ms temporal precision
b
Detection system
Emission system
Water cone
Stereotaxic frame
> 3 weeks
LED driver
635nm LED
Anesthesia system
c
Axial distance (mm)
Elevational distance (mm)
Lateral distance (mm)
Normalized pressure
d
Axial
Axial distance (mm)
Lateral
Lateral distance (mm)
Elevational
Elevational distance (mm)
Normalized intensity
e
NA
Air
Skull
Brain
I(z)
f
Intact skull
1000 mW
100 mW
10 mW
1 mW
Activation threshold
Intensity (mW/mm²)
Depth (mm)
g
Craniotomy
1000 mW
100 mW
10 mW
1 mW
Activation threshold
h
FUS
10 ms
50 ms
100 ms
Temperature increase (°C)
Time (s)
i
Light
5% DC
10% DC
50% DC
Temperature increase (°C)
Time (s)

Optogenetik



Optogenetik

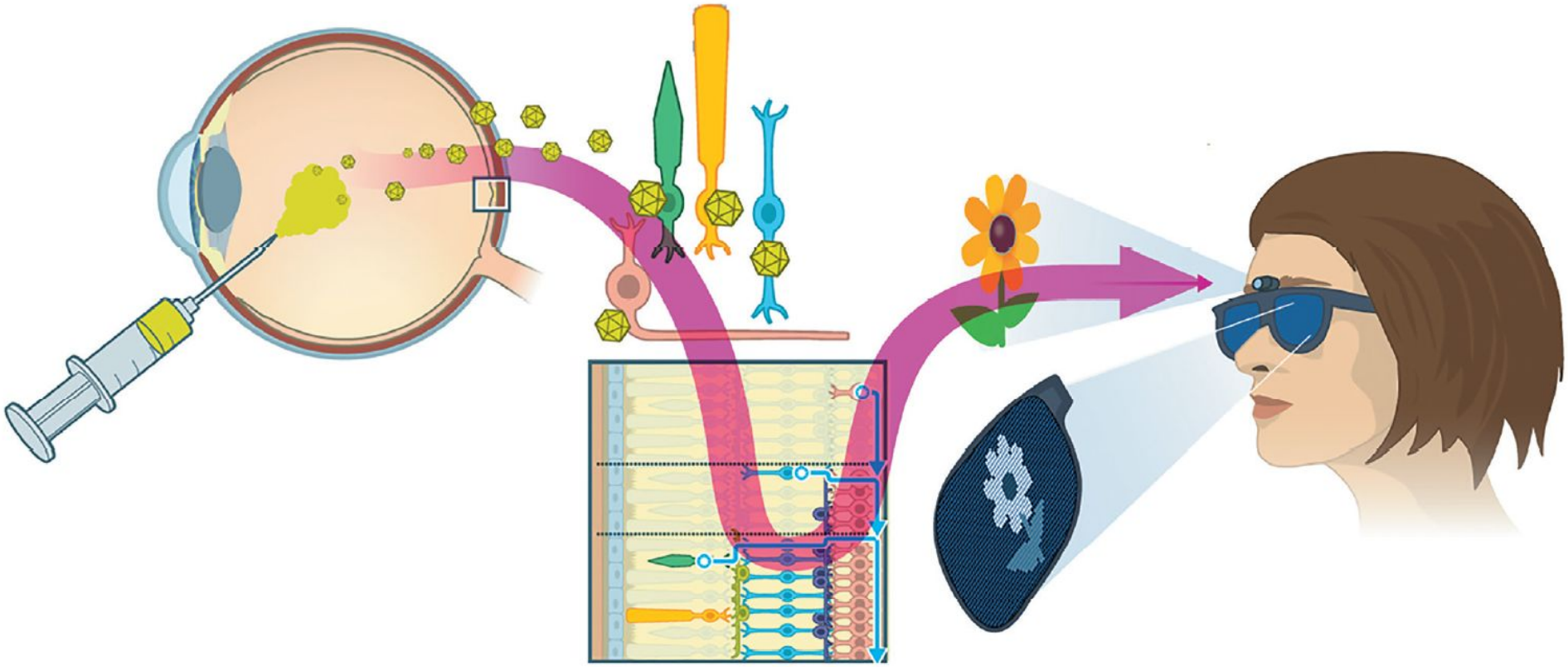
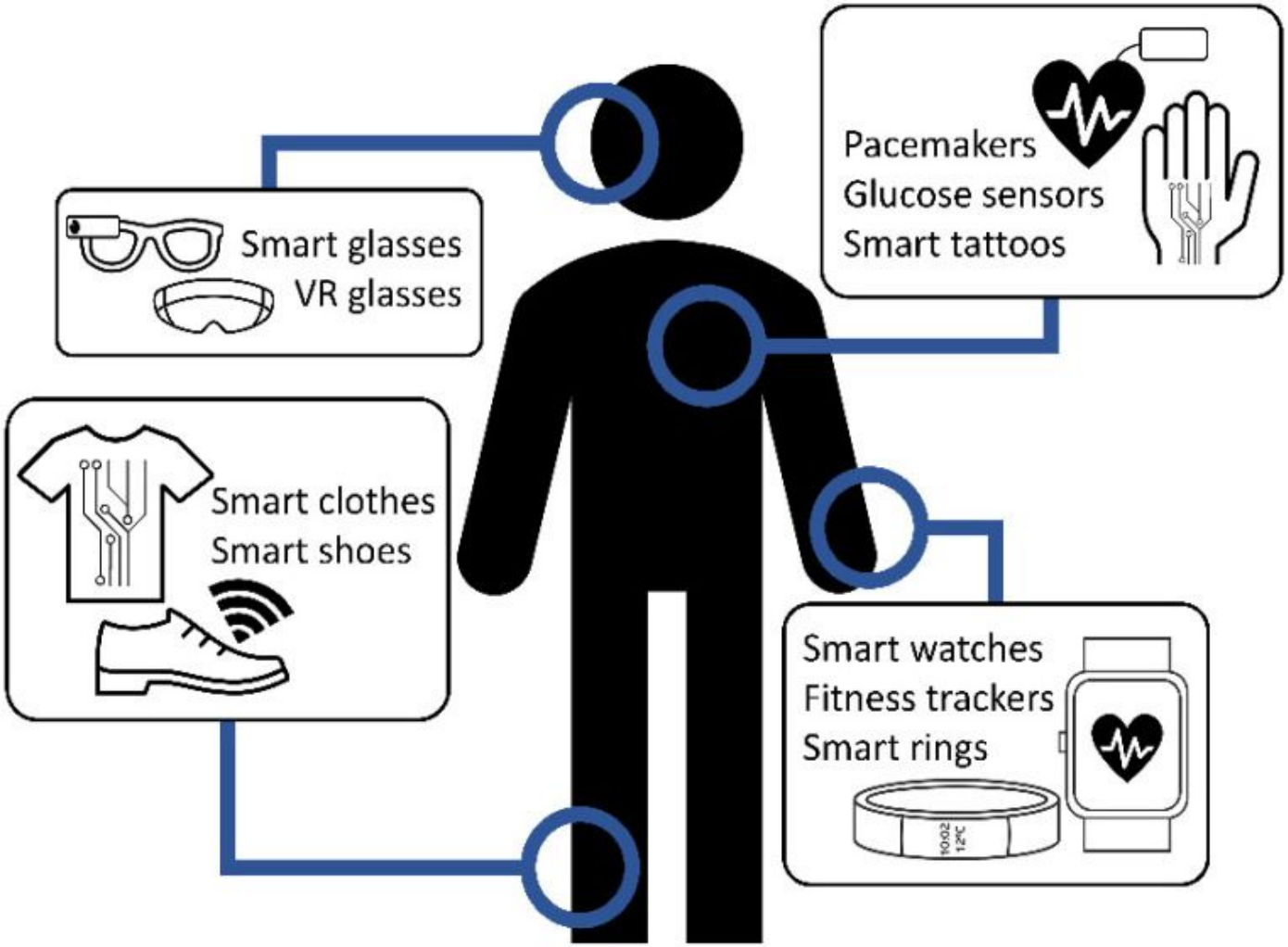


Figure: modified from Kleinlogel S, Vogl C, Jeschke M, Neef J, Moser T. Physiol Rev. 2020 100(4): 1467–1525. doi: 10.1152/physrev.00035.2019.

Páez-Montoro A, García-Valderas M, Olías-Ruíz E, López-Ongil C. Solar Energy Harvesting to Improve Capabilities of Wearable Devices.
Sensors (Basel). 2022 May 23;22(10):3950.
doi: 10.3390/s22103950. PMID: 35632358; PMCID: PMC9145634.



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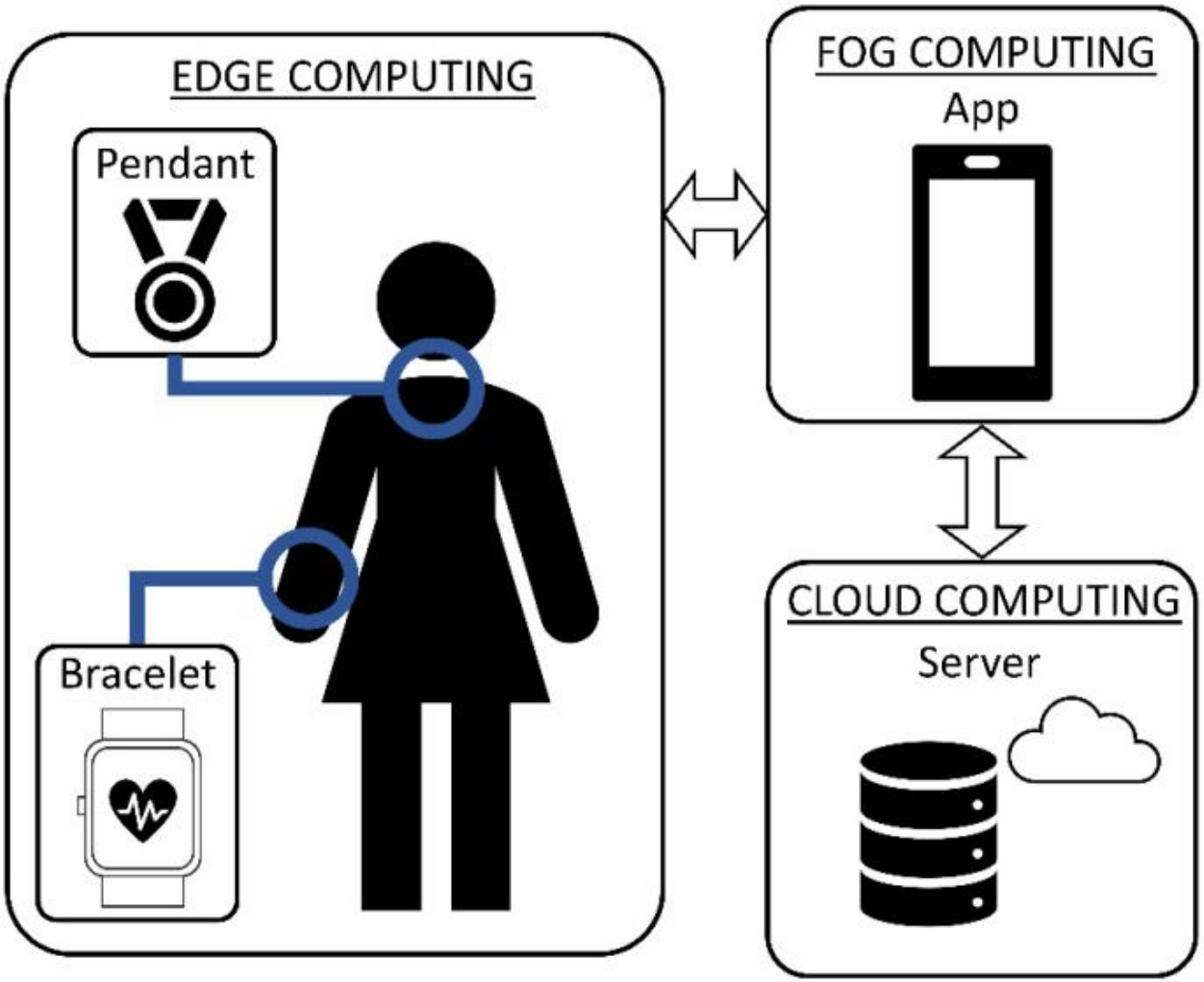

Páez-Montoro A, García-Valderas M, Olías-Ruíz E, López-Ongil C. Solar Energy Harvesting to Improve Capabilities of Wearable Devices.
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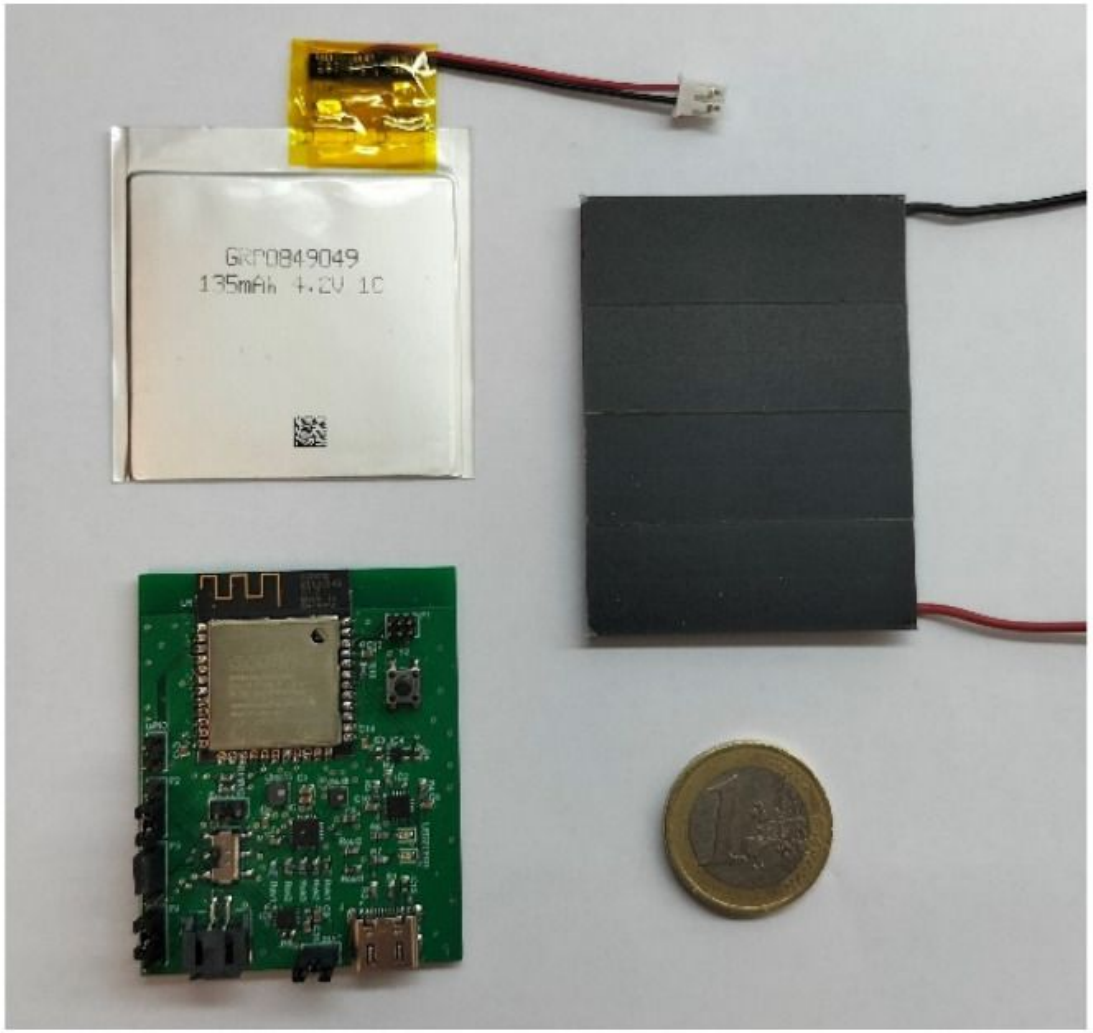

Páez-Montoro A, García-Valderas M, Olías-Ruíz E, López-Ongil C. Solar Energy Harvesting to Improve Capabilities of Wearable Devices.
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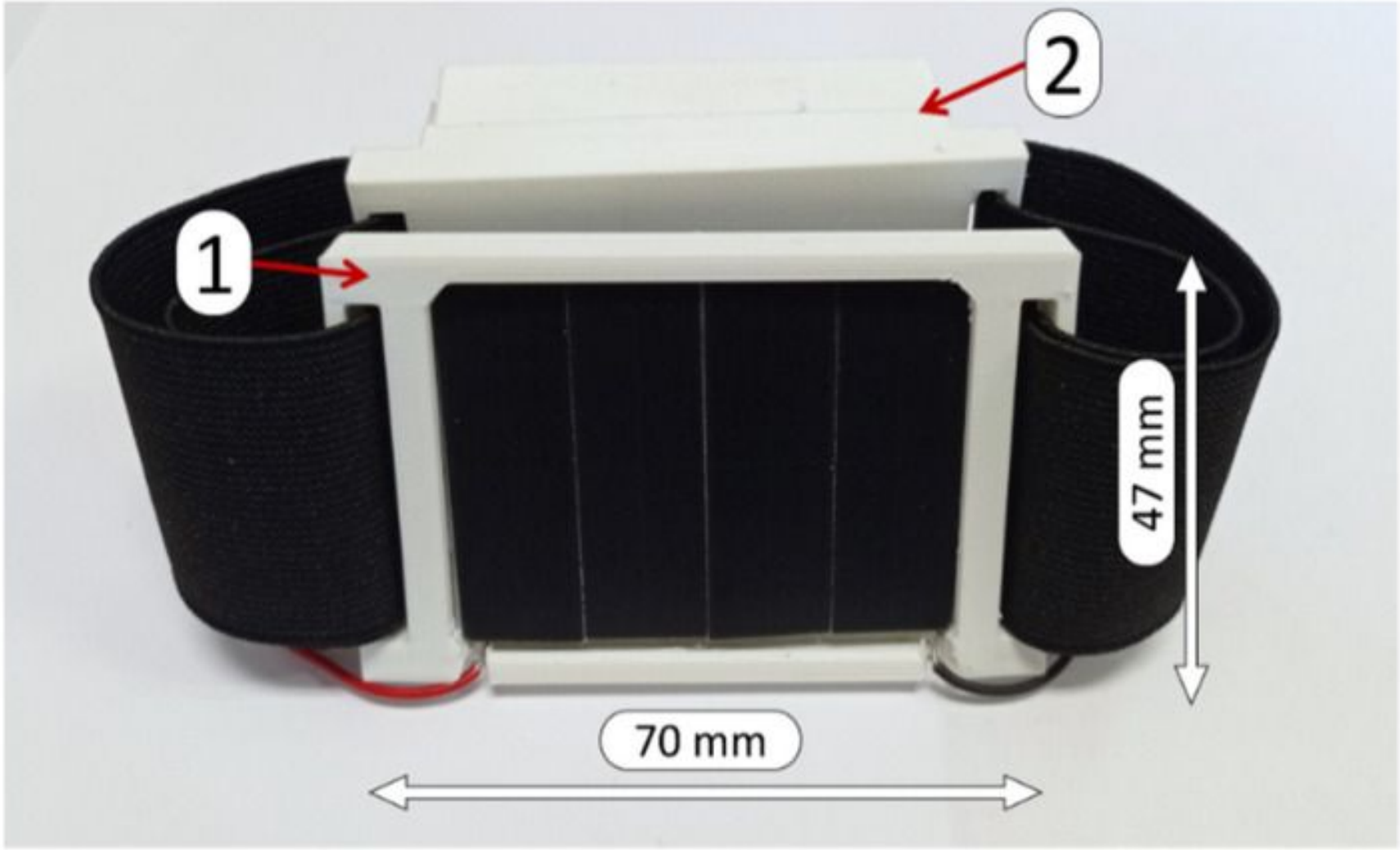
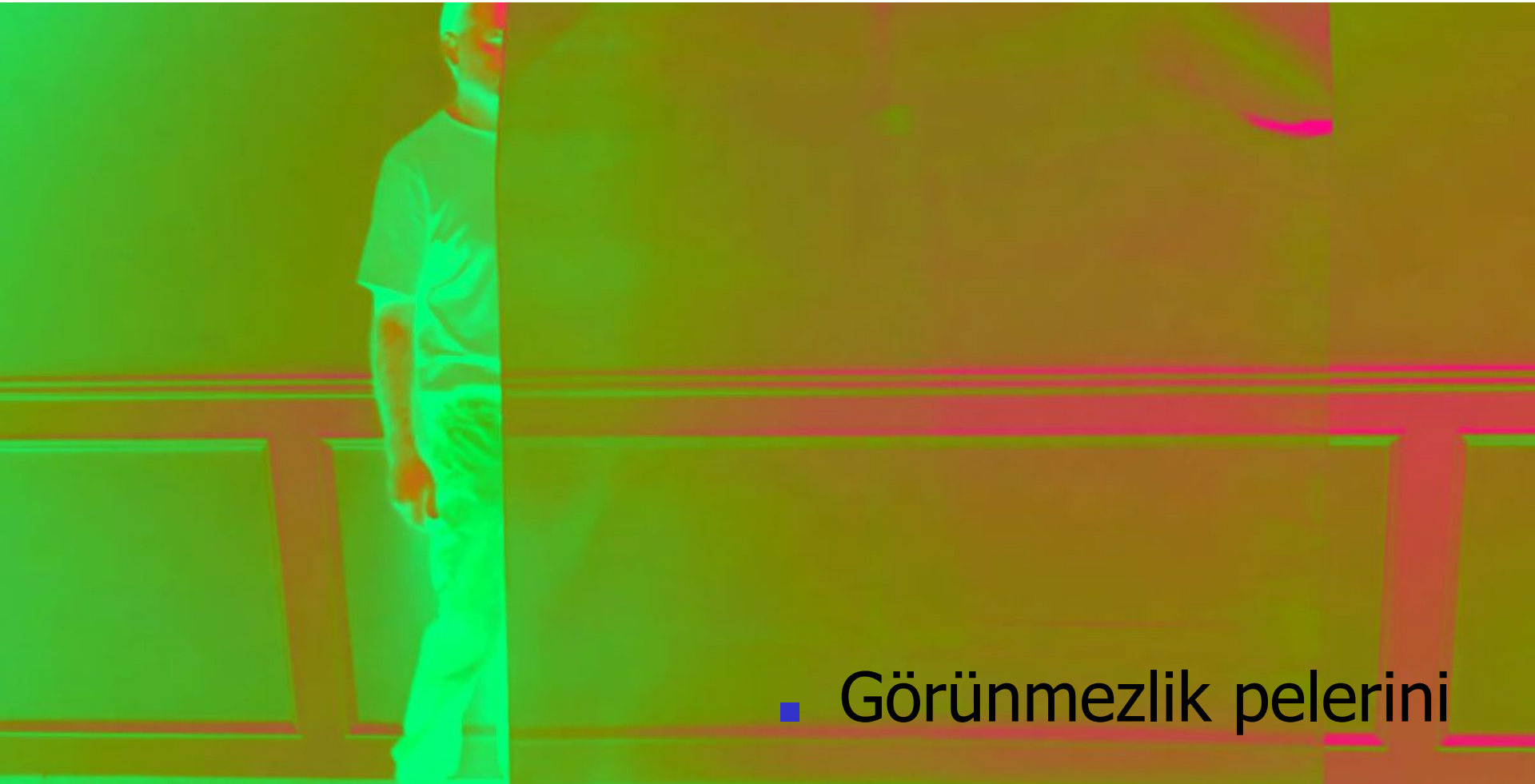


Quantum-Stealth-Material
HyperStealth Biotechnology Corporation

- Görünmezlik pelerini

Quantum-Stealth-Material
HyperStealth Biotechnology Corporation



- Görünmezlik pelerini

Quantum-Stealth-Material
HyperStealth Biotechnology Corporation

- Görünmezlik pelerini

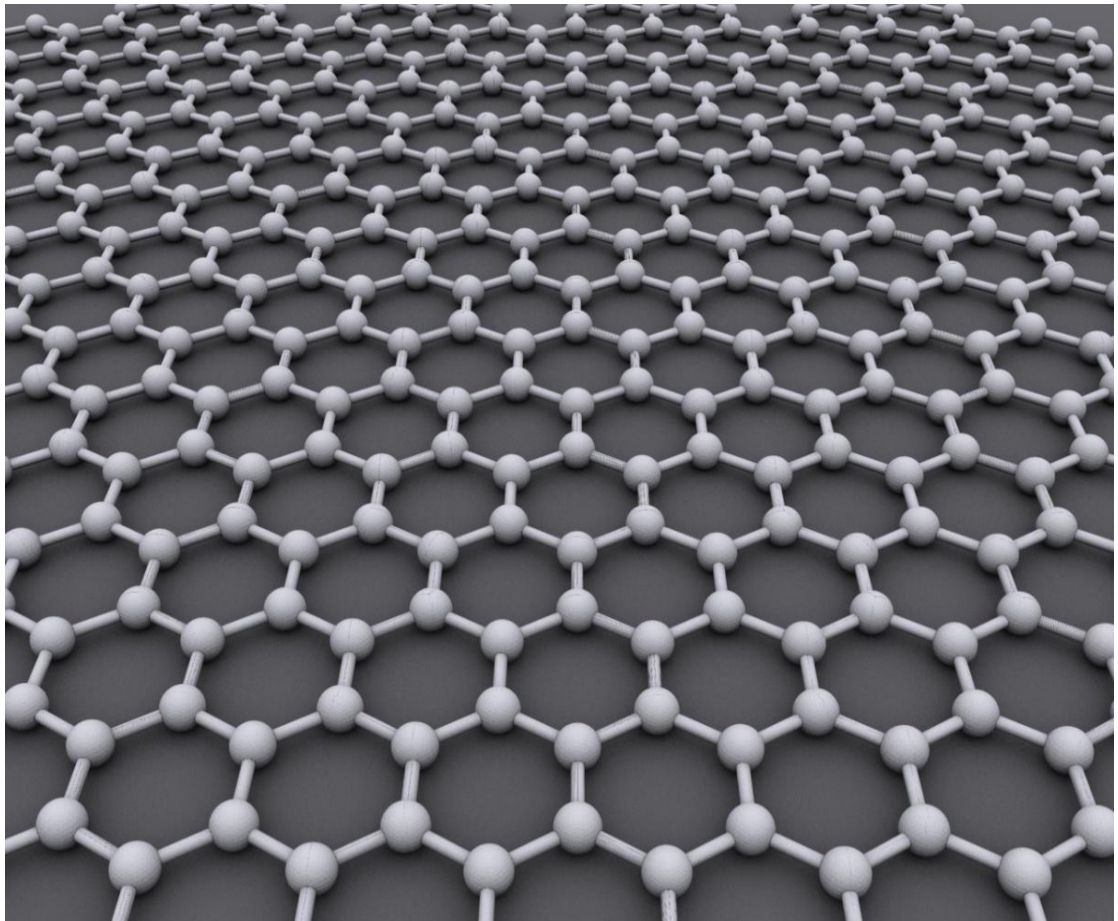
Metamaterial

- Doğal malzemelerde bulunmayan özelliklere sahip olacak şekilde tasarlanmış yapay malzemeler.

- Plastik
- metal gibi doğal malzemeler
- mikroskobik yapılar:
- tekrarlanan desenler>>> birleştirme

Grafen
2D (!) materyal

- Tek atom katlı karbon kristali



Grafen
2D (!) materyal

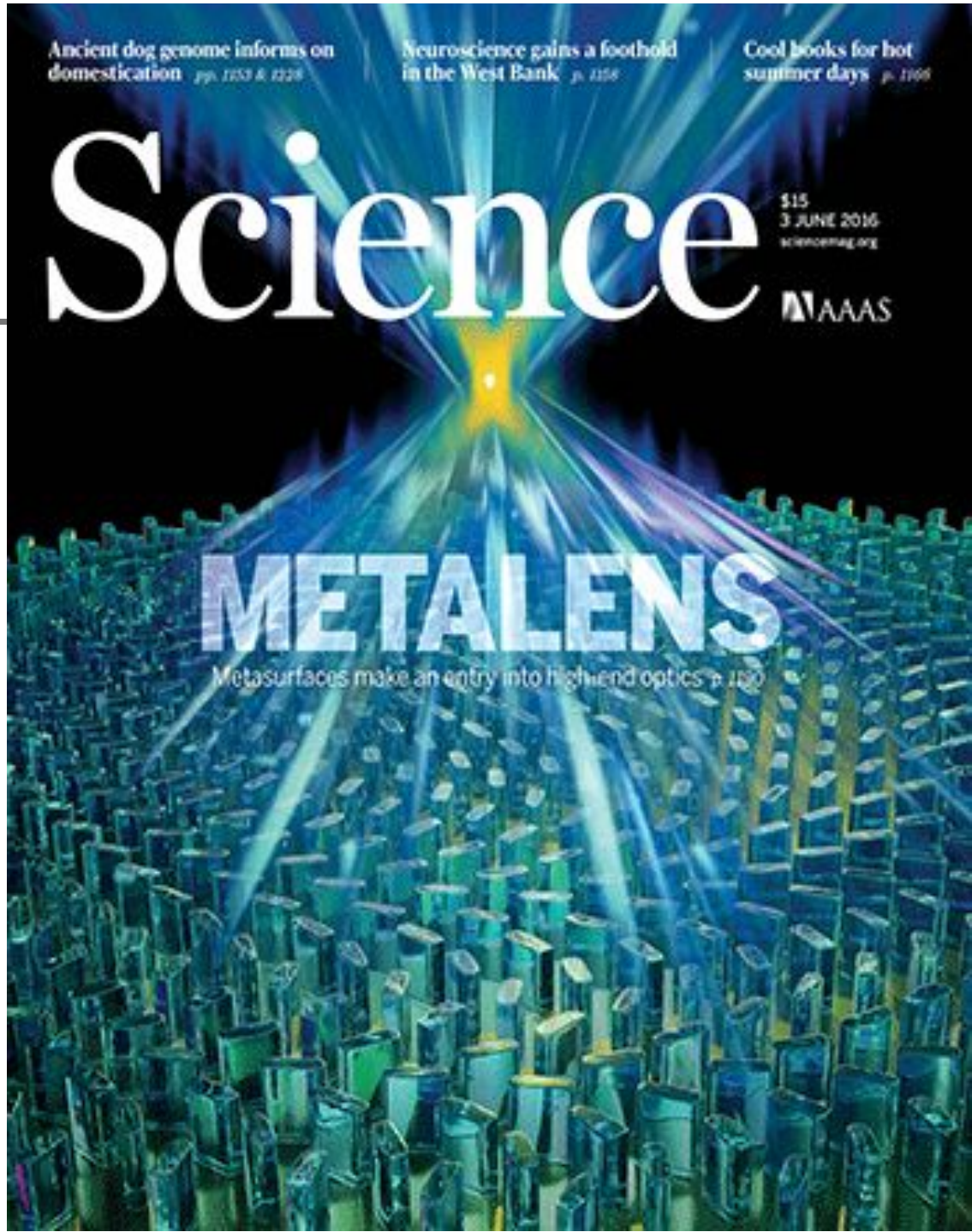
- Şeffaf
- Esnek
- Kimyasal ve biyolojik: İnert!

Grafen
2D (!) materyal

- Araştırmacılar: Süper malzeme!
- Tek bir tabaka kalınlığında karbon atomu

- Süper güçlü (çelikten daha dayanıklı)
- Süper esnek
- Süper hafif
- Elektriksel iletkenlik (bakırdan daha iyi)
- Biyolojik olarak parçalanabilen

Metalens

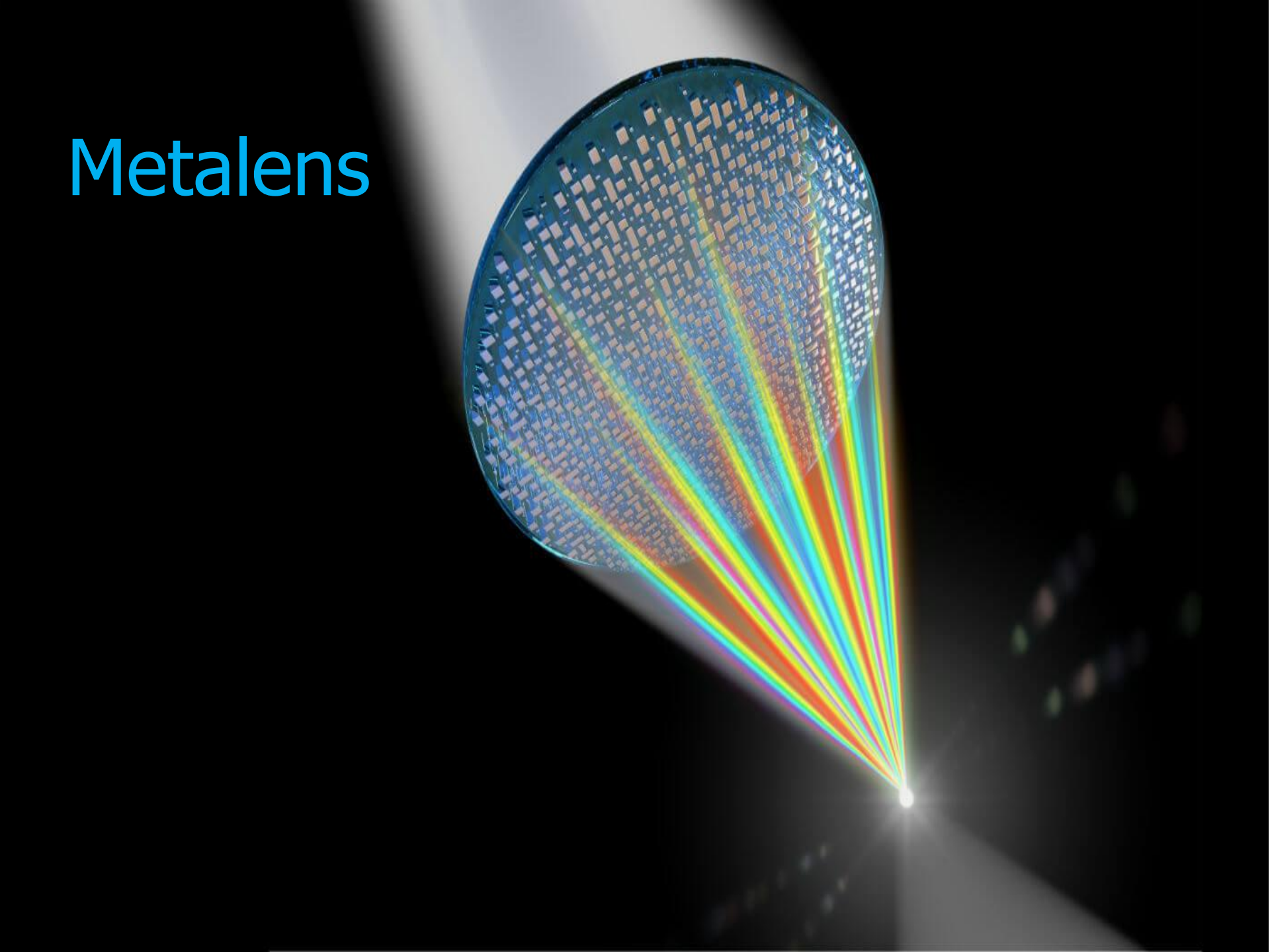

Ancient dog genome informs on domestication
Neuroscience gains a foothold in the West Bank
Cool books for hot summer days
Science
$15
3 JUNE 2016
sciencemag.org
AAAS
METALENS
Metasurfaces make an entry into highend optics

Metalens

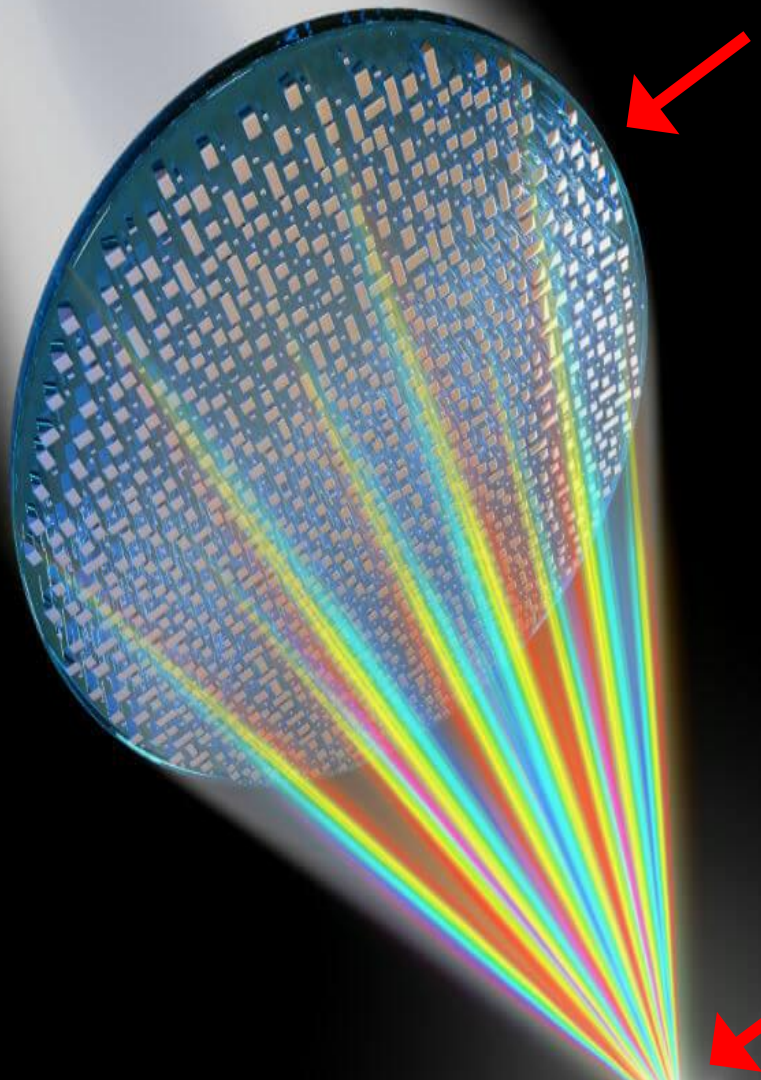
- Metamateryal

- İnce
- Üretilmesi kolay
- Uygun maliyetli

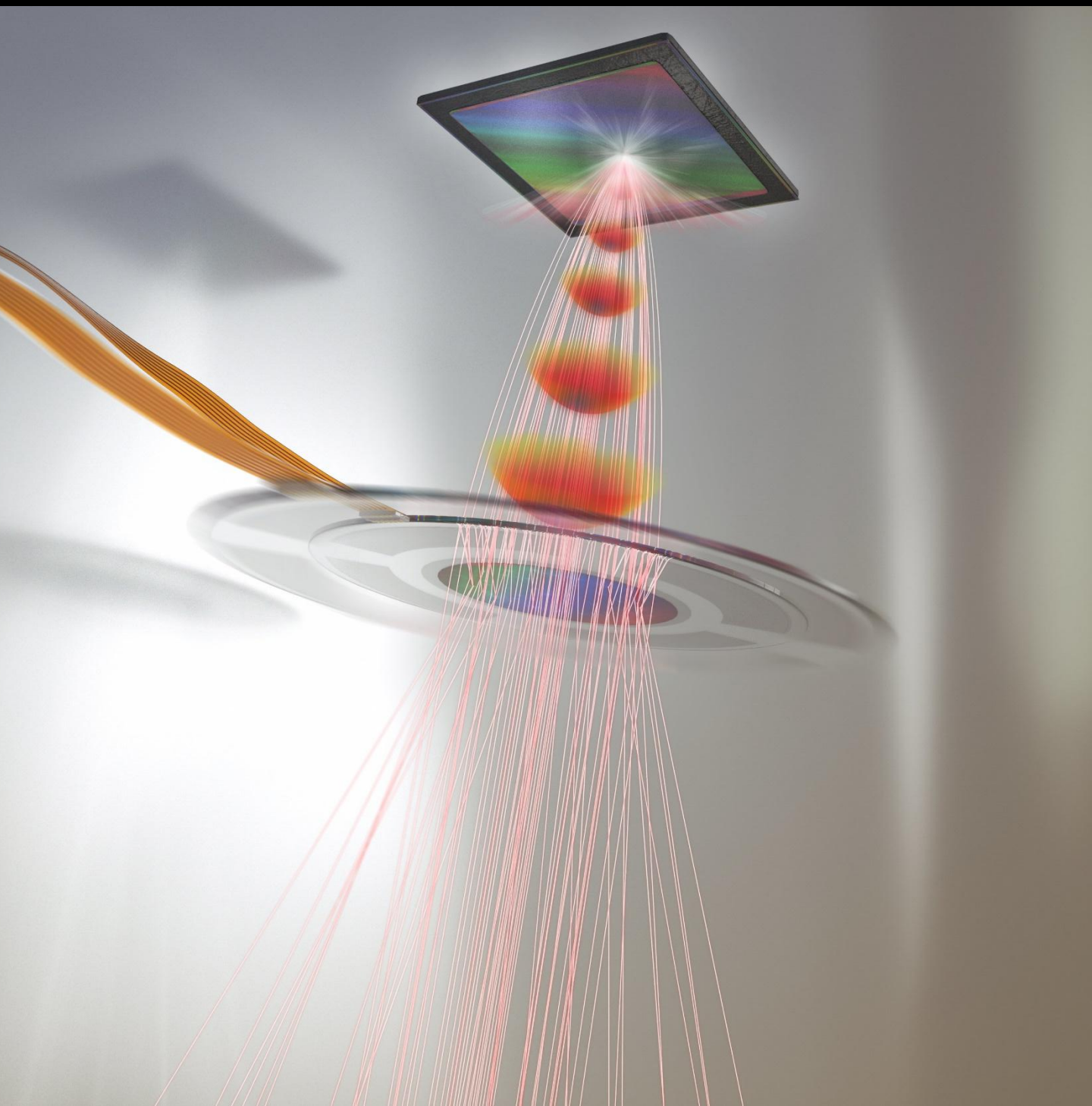
Metalens



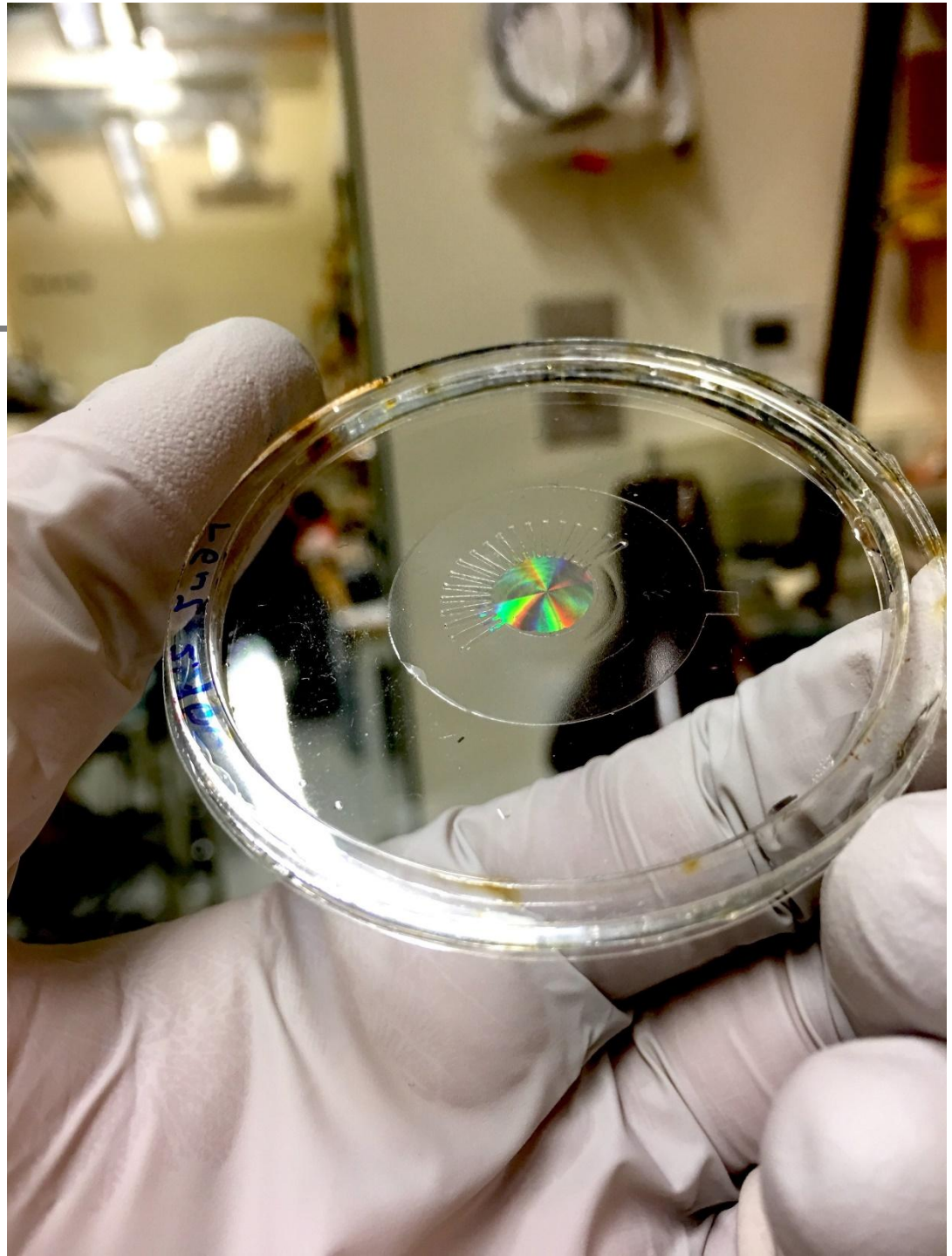
Metalens



- Kromatik aberasyon yok / oluşmuyor

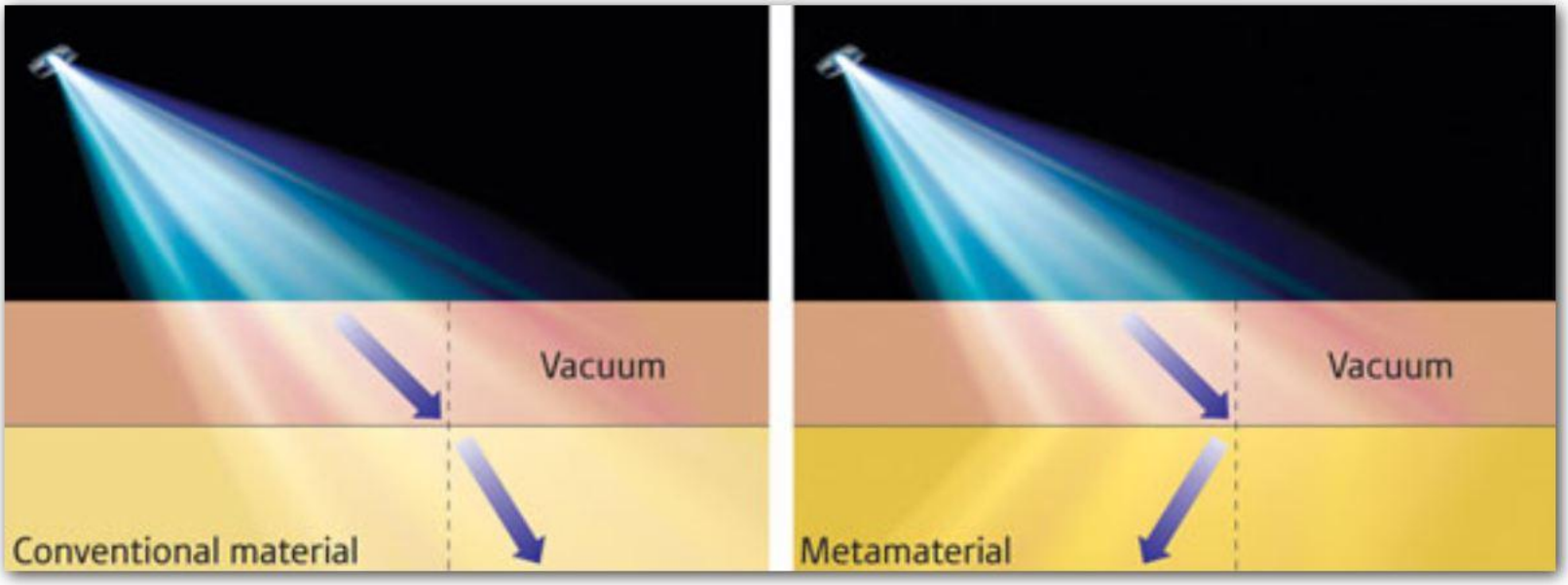


Metalens



Metalens Avantajlar

- Negatif refraktif endeks



Adaptif metalensler

- Cep telefonu kameraları
- Mikroskop

- Düz
- Kompakt otomatik odaklama
- Optik aberasyonları eş zamanlı düzeltme
- Optik görüntü sabitleme

Adaptif metalensler

- Cep telefonu kameraları
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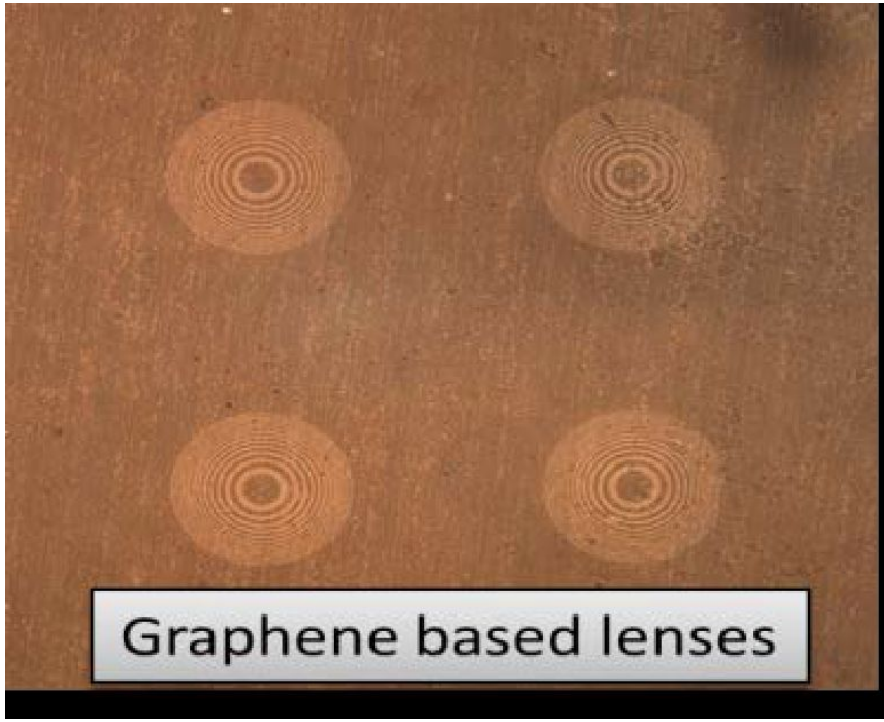
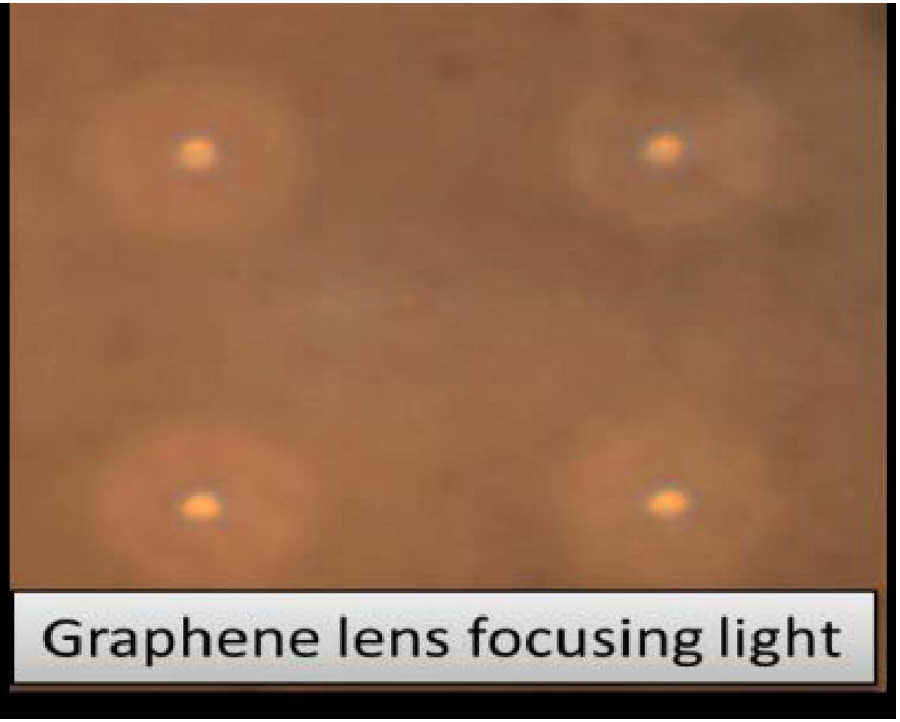
Graphene based Ultra-Thin Flat Lenses 1.375 inches high x 3.5 inches wide





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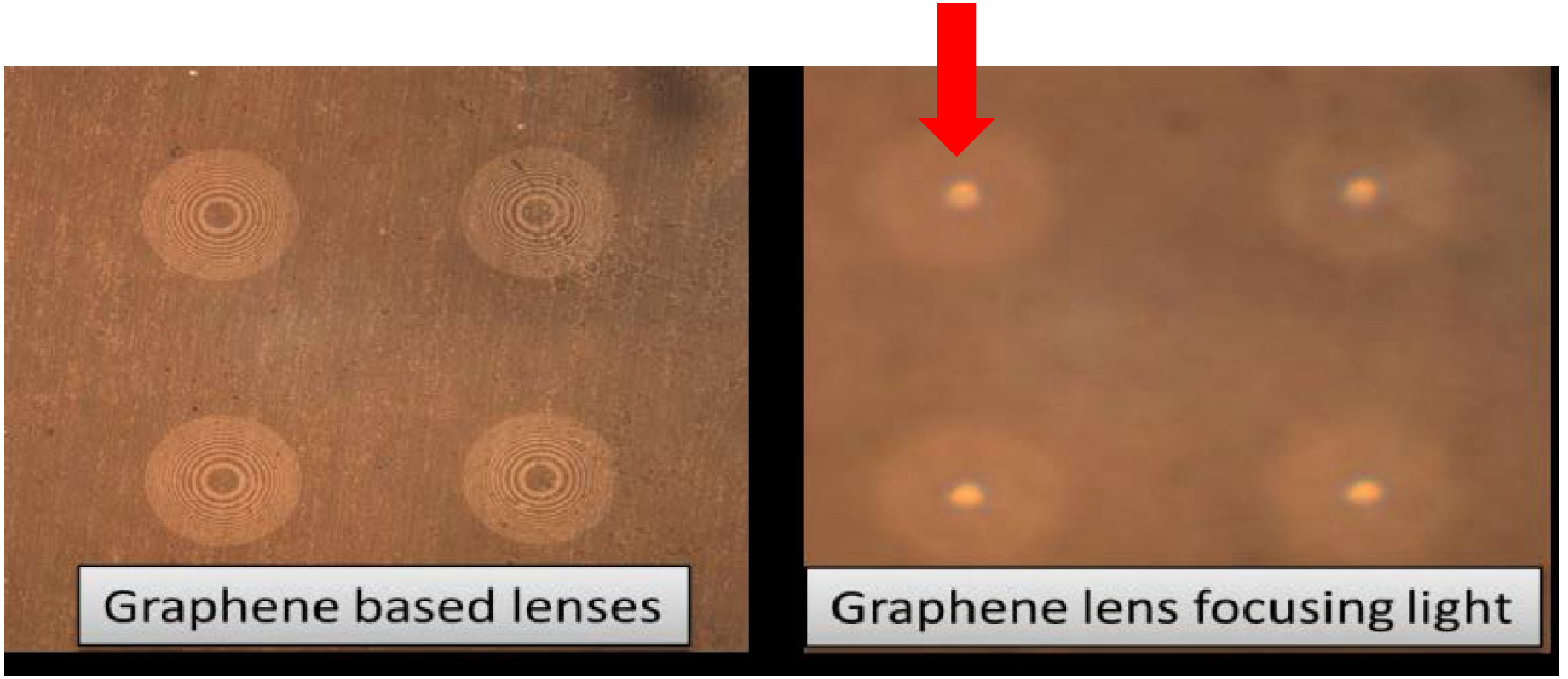
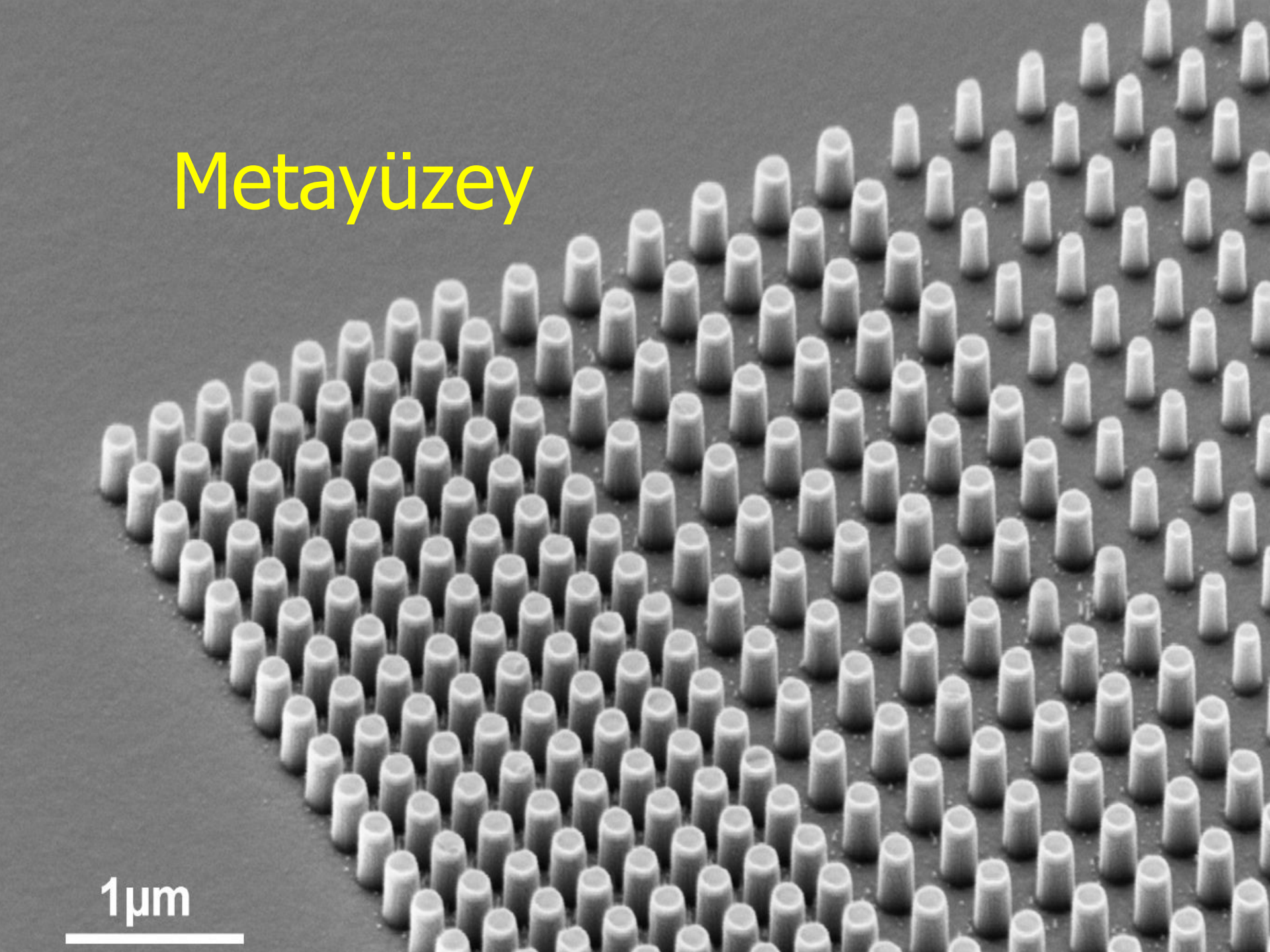
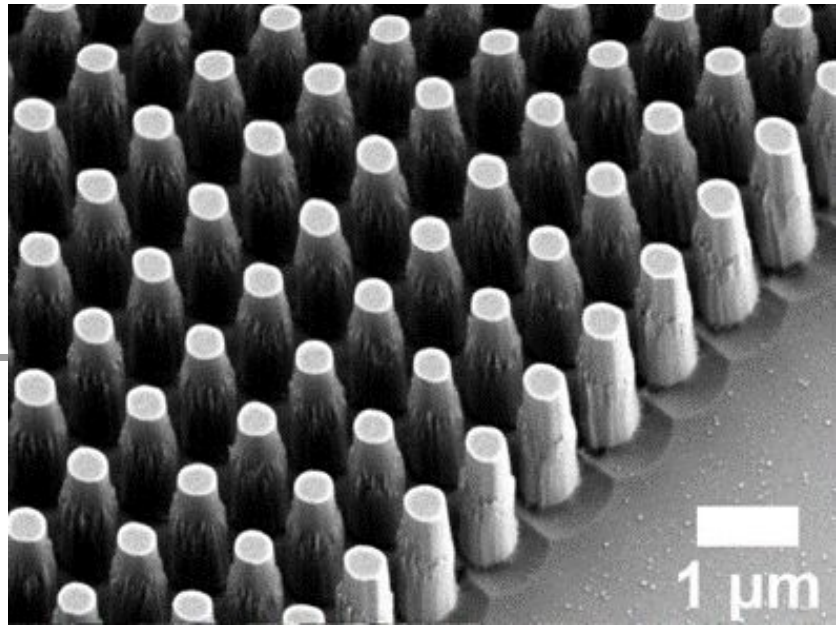
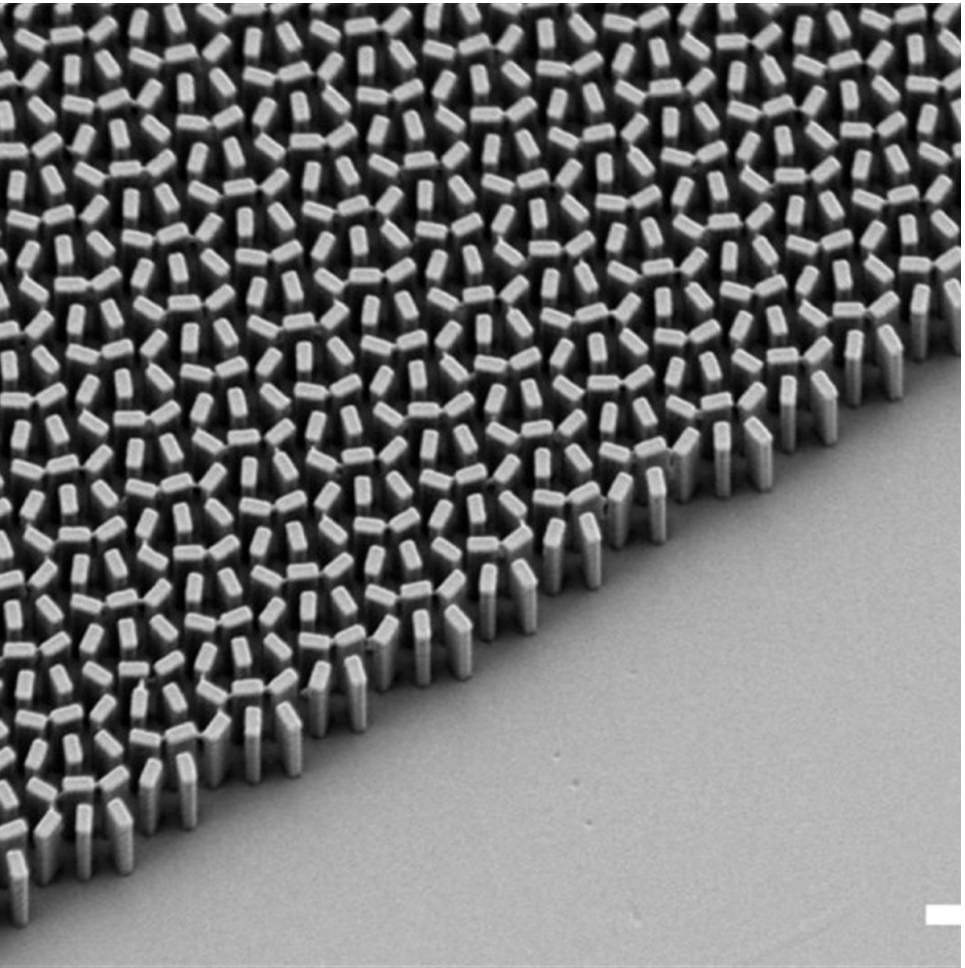
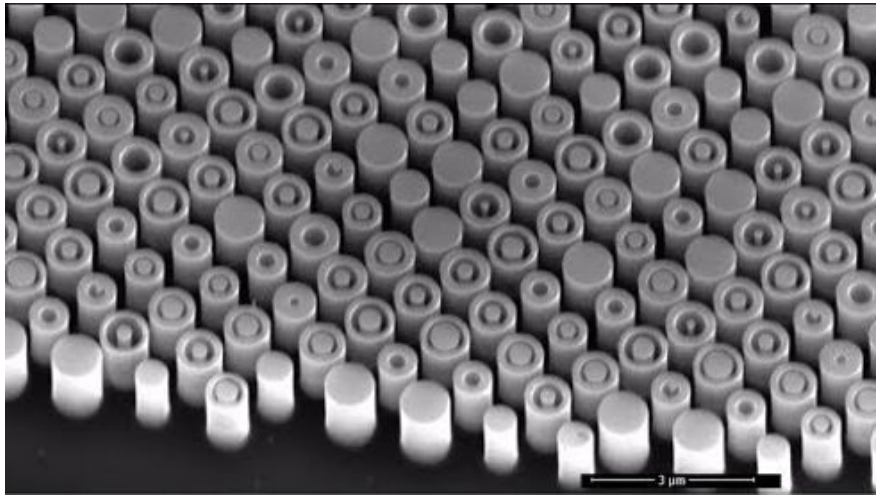



Metayüzey
1µm

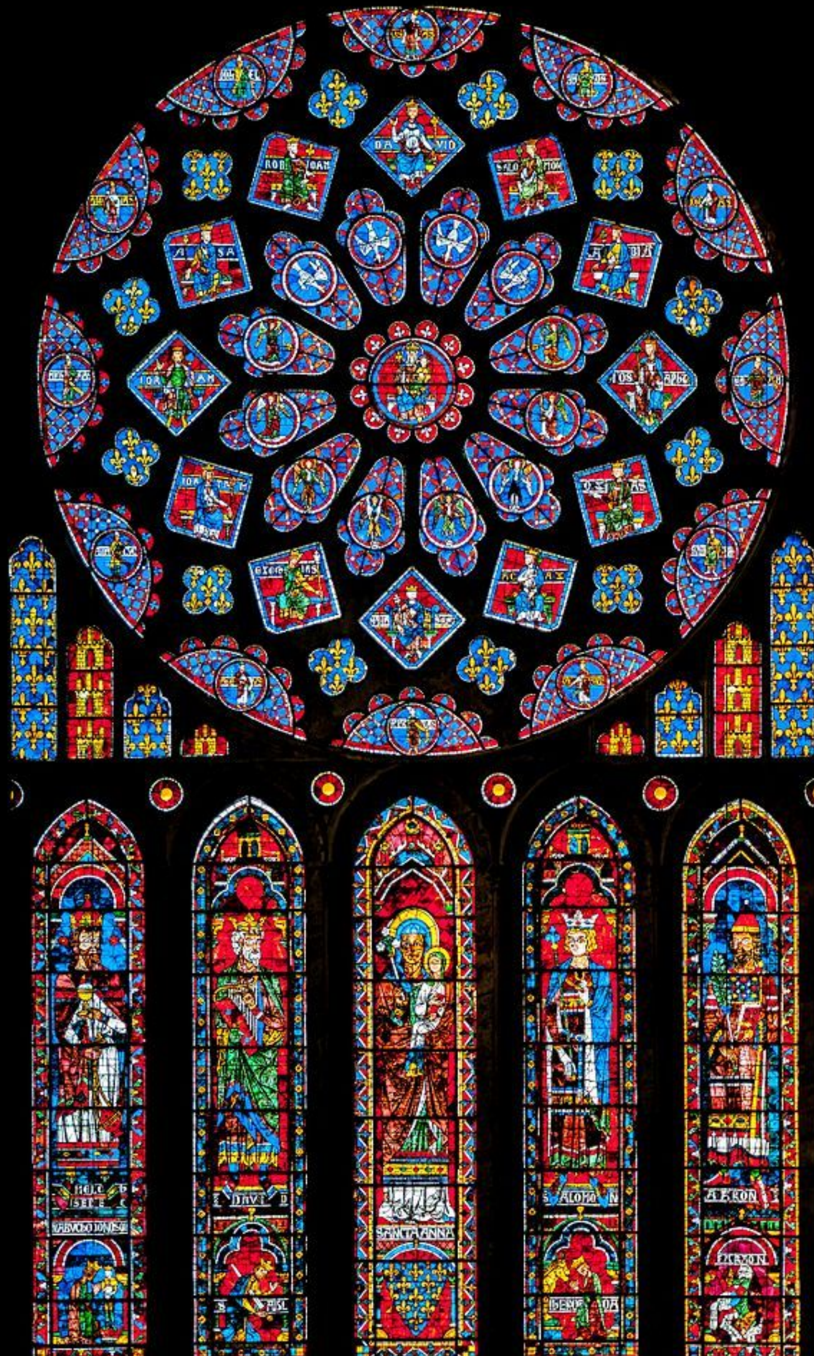
Metasurfaces







Plazmonik renkler


SANCTA ANNA

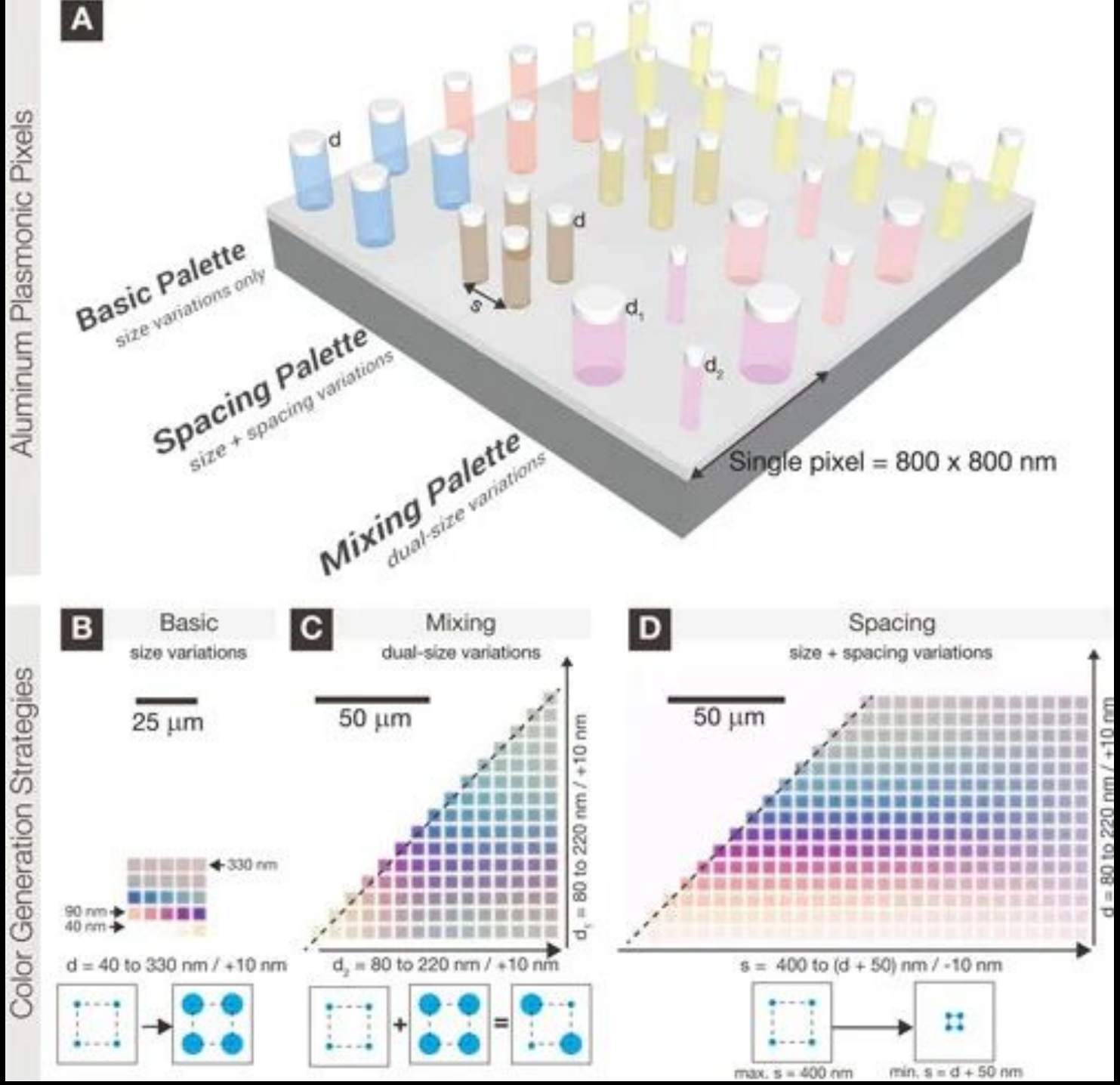
Metayüzeyler ve Aydınlatma

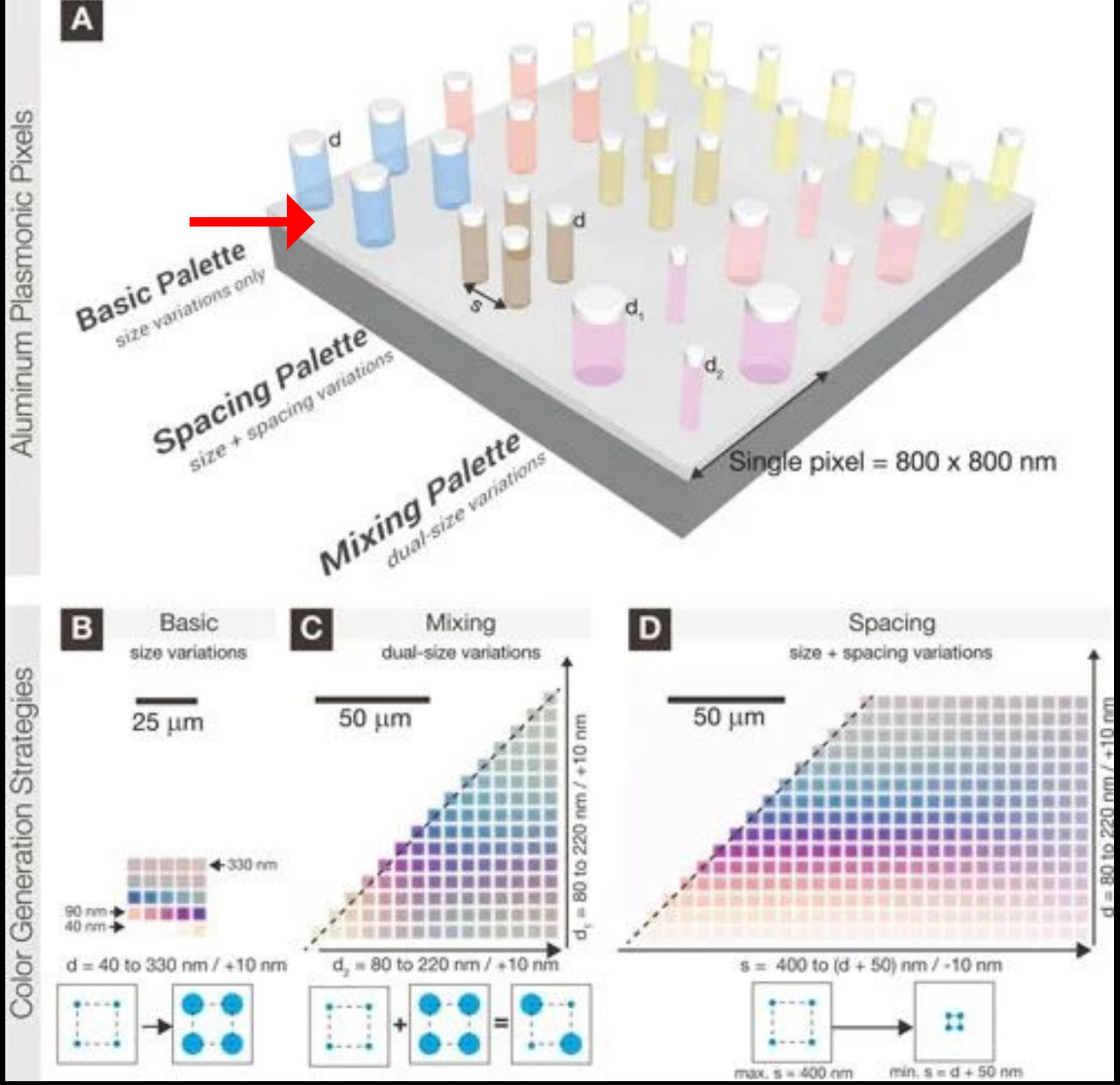
- Işığın bir malzeme yüzeyiyle etkileşimini değiştirmek için tasarlanmış yapay yapılar içeren optik etkili yüzeyler.

Metayüzeyler ve Aydınlatma

- Işığın bir malzeme yüzeyiyle etkileşimini değiştirmek için tasarlanmış yapay yapılar içeren optik etkili yüzeyler.

- Yansıma Kontrolü
- Işık Kırılması ve Dağılımı
- Renk Kontrolü
- Parlaklık Kontrolü


Aluminum Plasmonic Pixels
A
Basic Palette
size variations only
Spacing Palette
size + spacing variations
Mixing Palette
dual-size variations
d
d
s
d1
d2
Single pixel = 800 x 800 nm
Color Generation Strategies
B
Basic
size variations
25 µm
330 nm
90 nm
40 nm
d = 40 to 330 nm / +10 nm
C
Mixing
dual-size variations
50 µm
d1 = 80 to 220 nm / +10 nm
d2 = 80 to 220 nm / +10 nm
D
Spacing
size + spacing variations
50 µm
d = 80 to 220 nm / +10 nm
s = 400 to (d + 50) nm / -10 nm
max. s = 400 nm
min. s = d + 50 nm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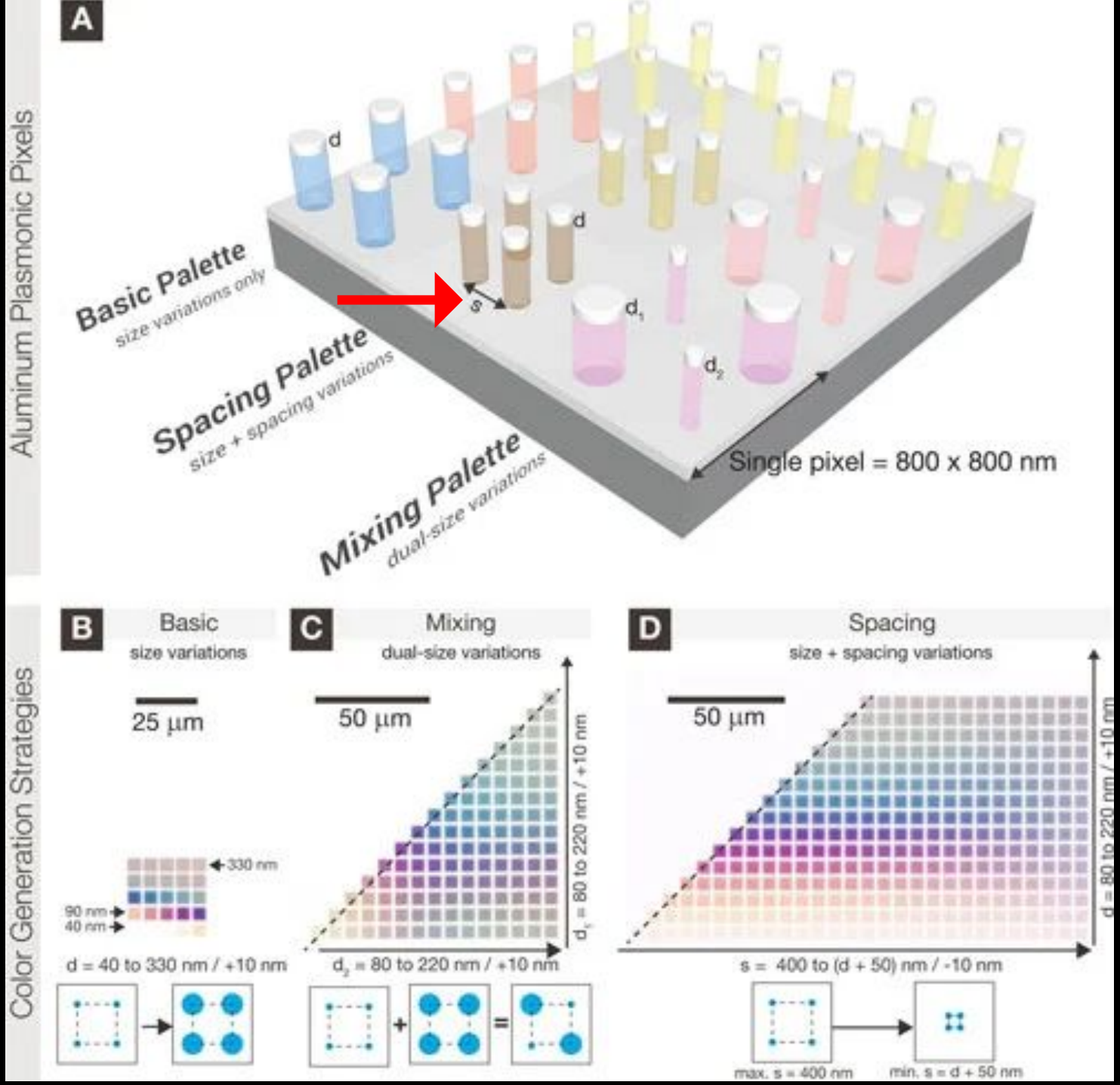
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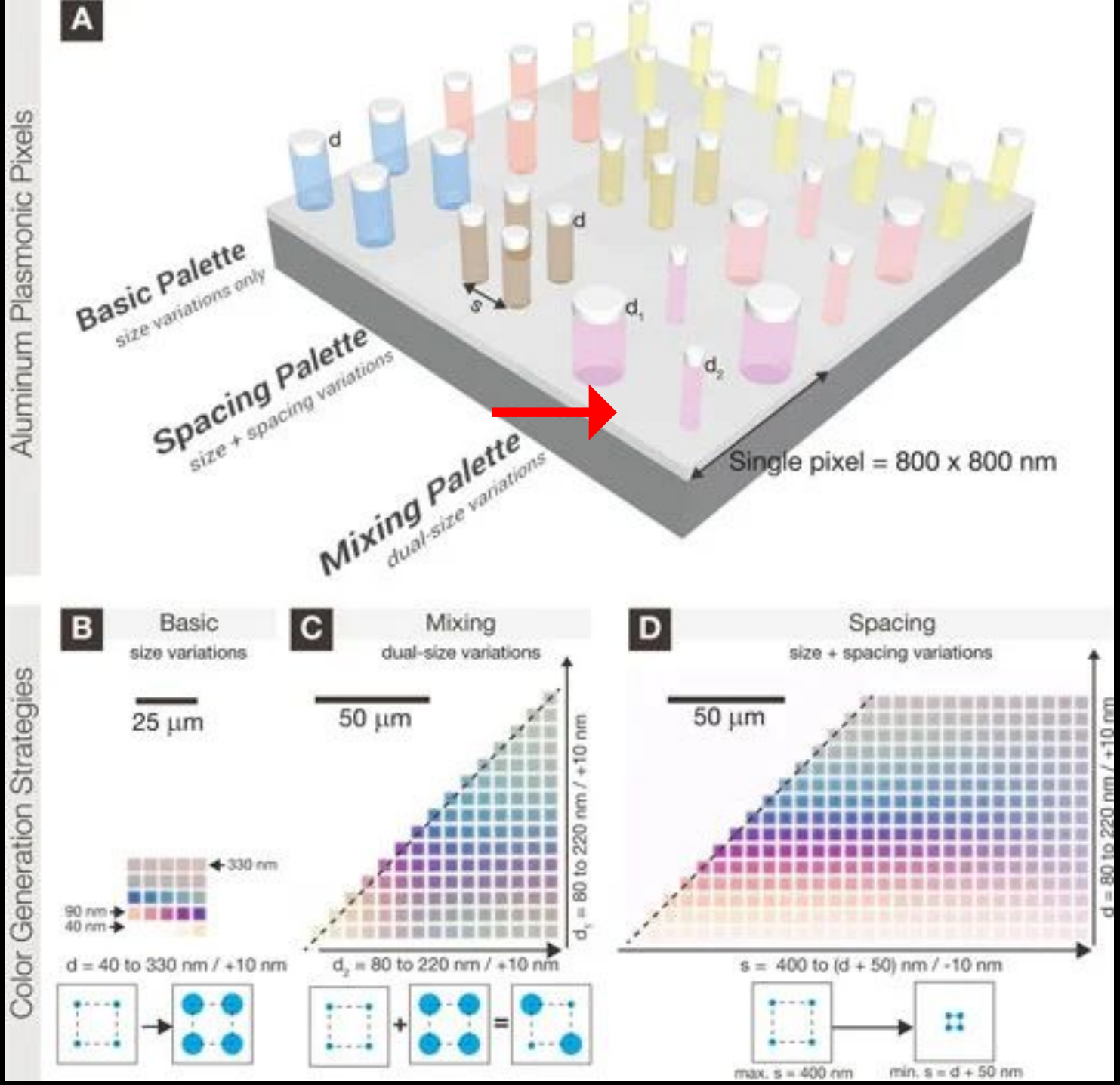
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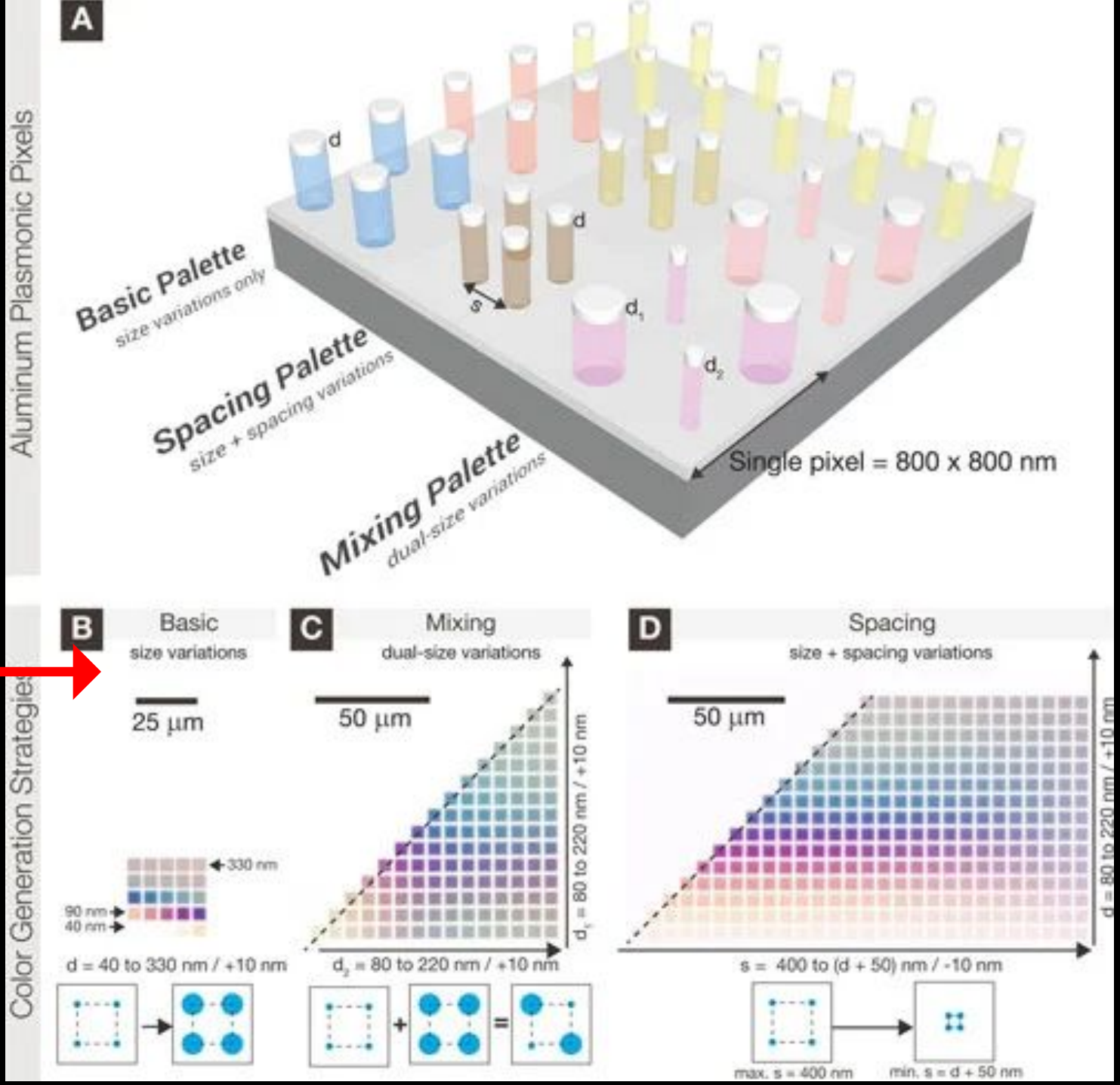
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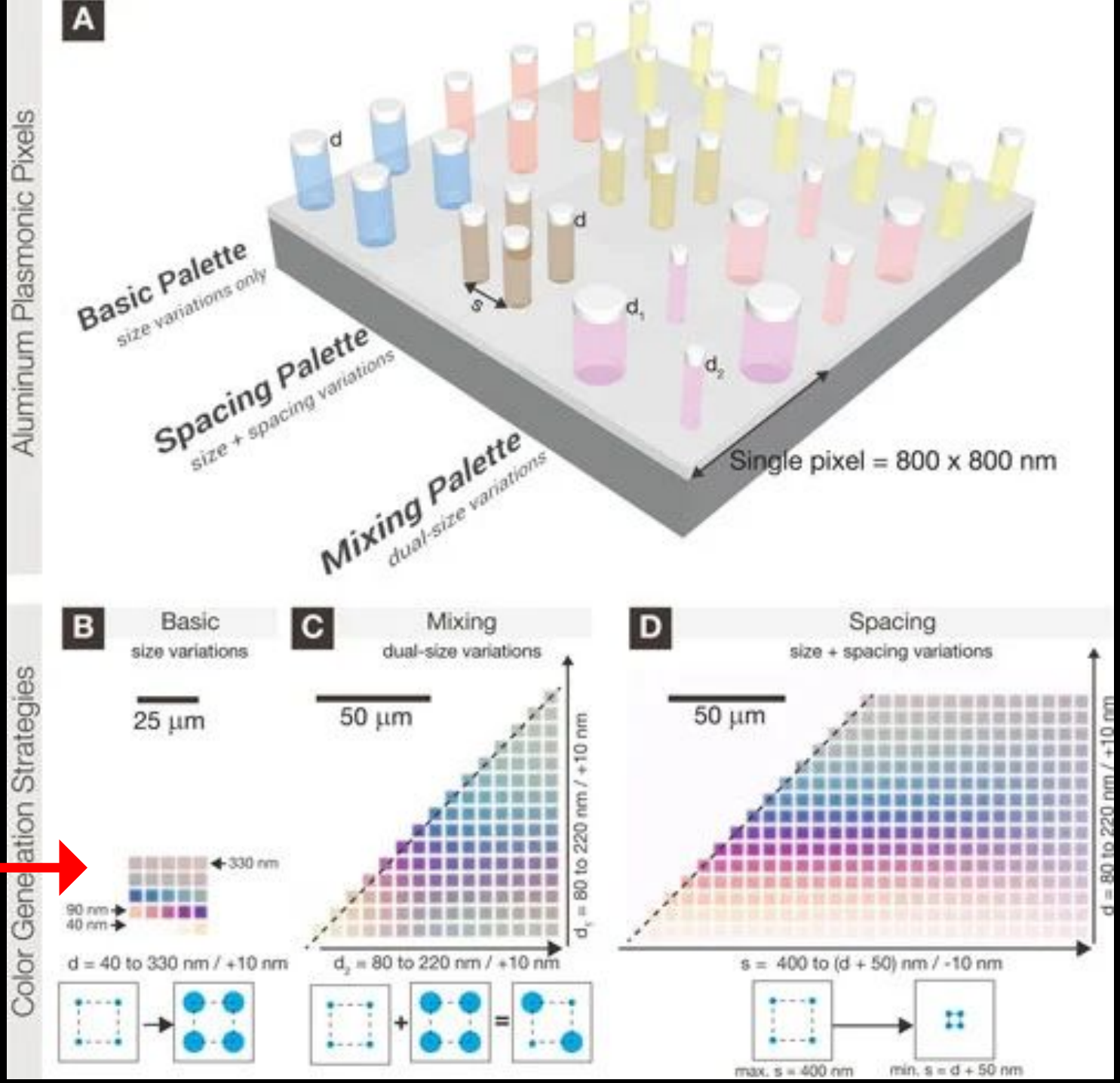
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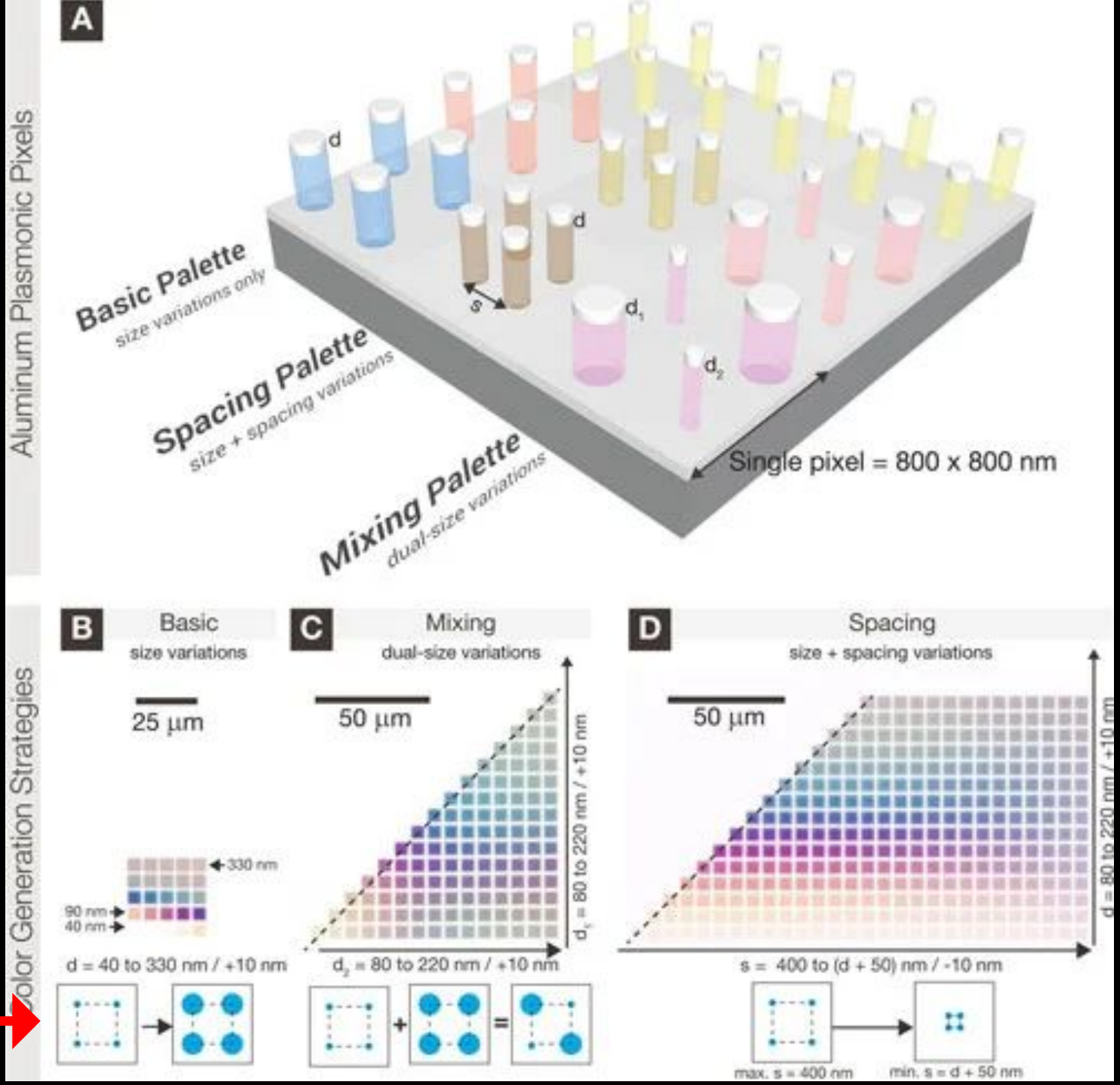
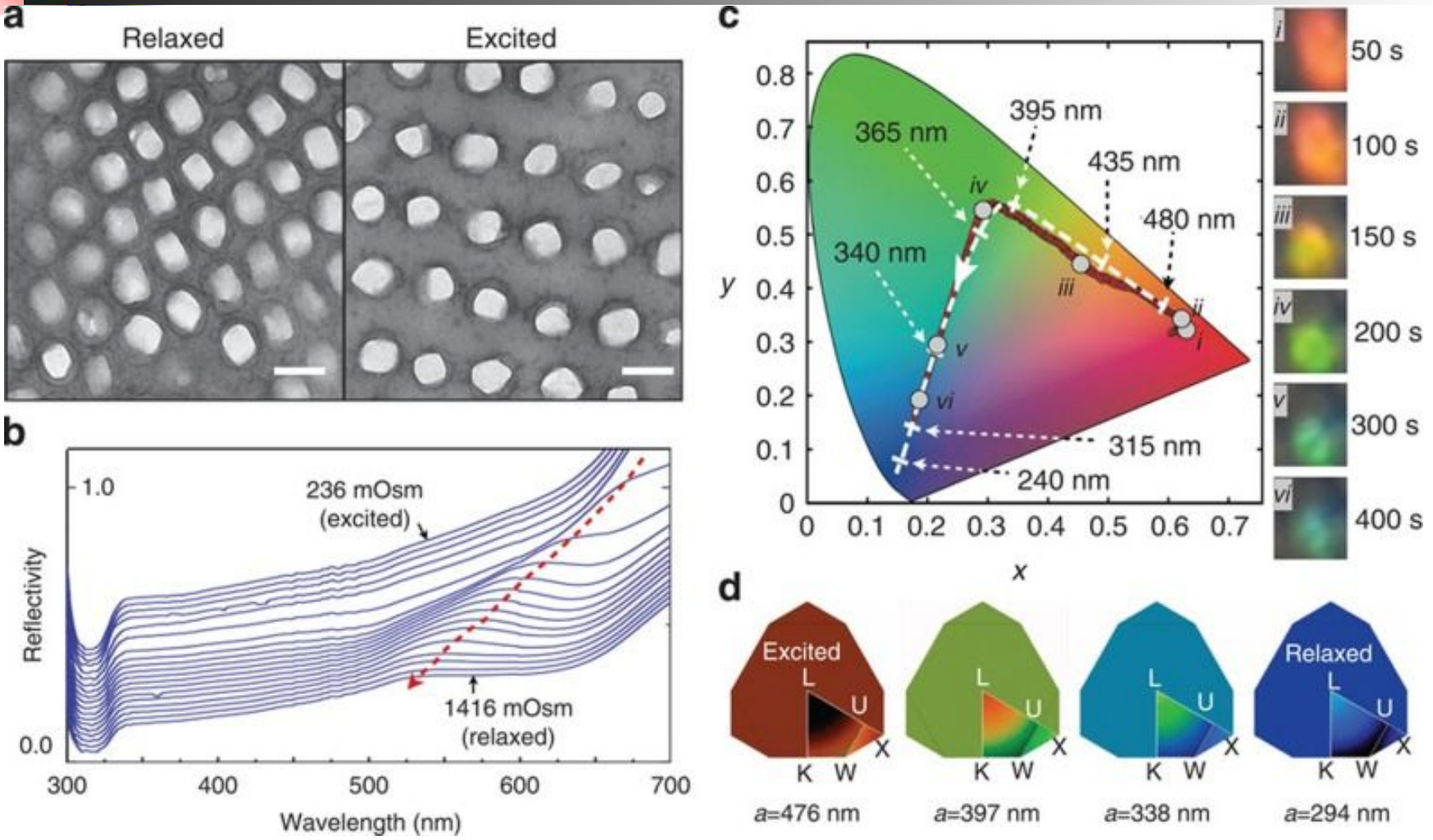
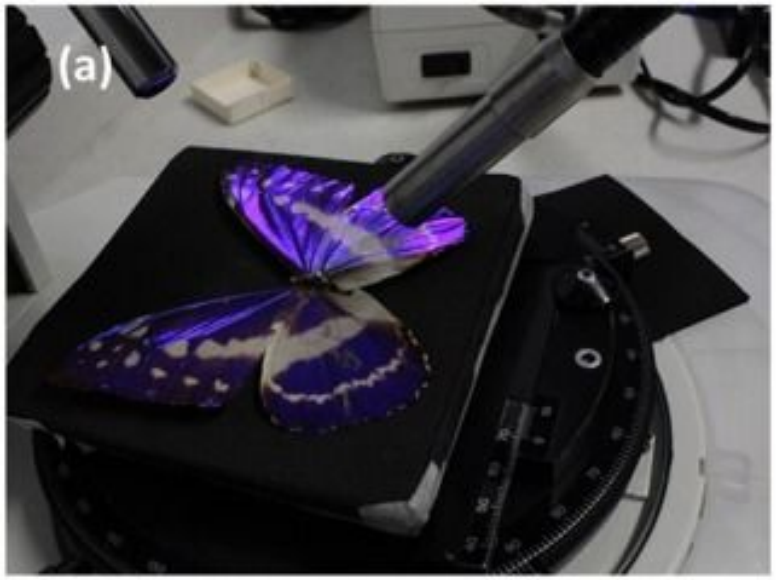
max. s = 400 nm
min. s = d + 50 nm

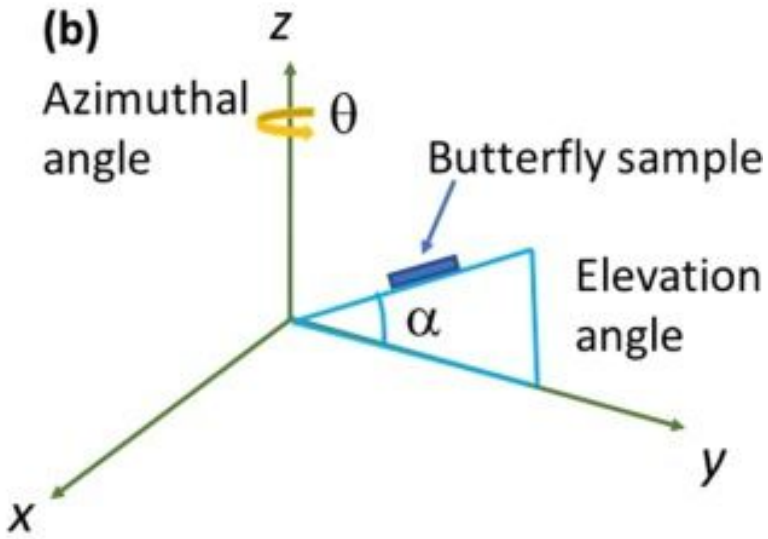

Aluminum Plasmonic Pixels
A
Basic Palette
size variations only
Spacing Palette
size + spacing variations
Mixing Palette
dual-size variations
d
d
s
d1
d2
Single pixel = 800 x 800 nm
Color Generation Strategies
B
Basic
size variations
25 µm
330 nm
90 nm
40 nm
d = 40 to 330 nm / +10 nm
C
Mixing
dual-size variations
50 µm
d1 = 80 to 220 nm / +10 nm
d2 = 80 to 220 nm / +10 nm
D
Spacing
size + spacing variations
50 µm
d = 80 to 220 nm / +10 nm
s = 400 to (d + 50) nm / -10 nm
max. s = 400 nm
min. s = d + 50 nm

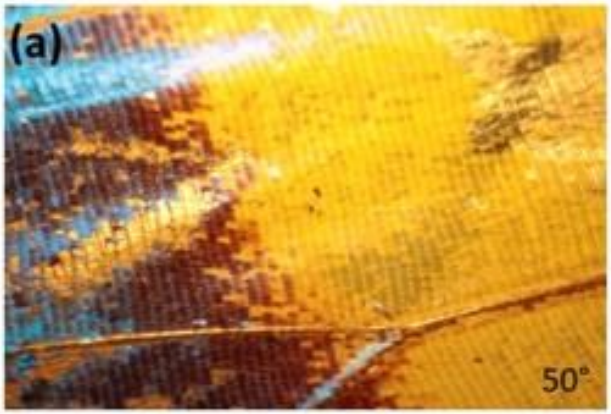
Teyssier J, Saenko SV, van der Marel D, Milinkovitch MC. Photonic crystals cause active colour change in chameleons. Nat Commun. 2015;6:6368. Published 2015 Mar 10. doi:10.1038/ncomms7368

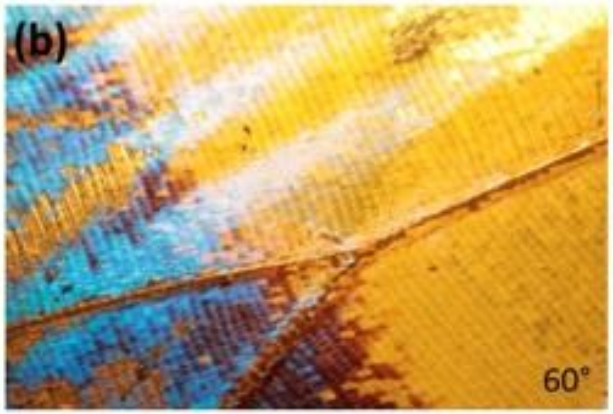


Barrera-Patiño, C.P., Vollet-Filho, J.D., Teixeira-Rosa, R.G. et al. Photonic effects in natural nanostructures on Morpho cypris and Greta oto butterfly wings.
Sci Rep 10, 5786 (2020).
https://doi.org/10.1038/s41598-020-62770-w

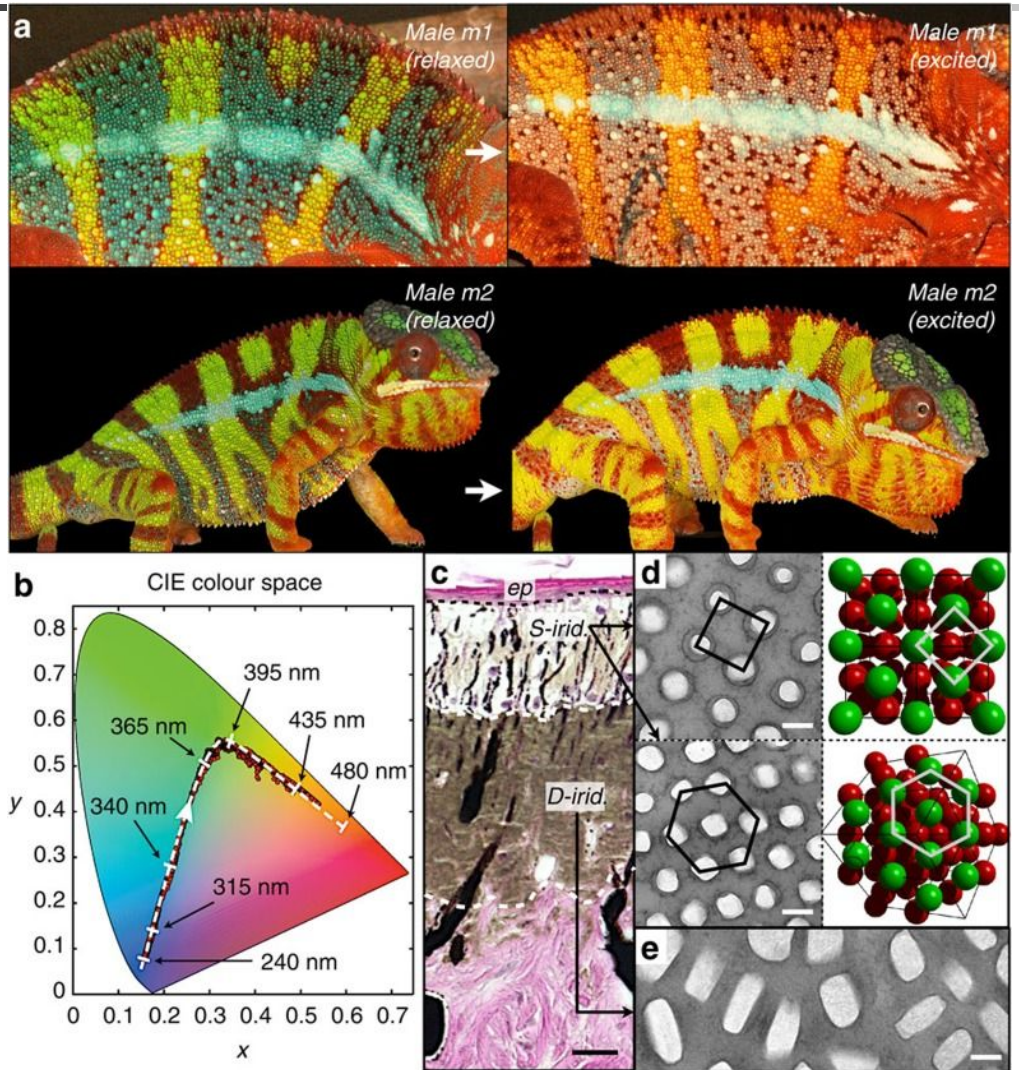




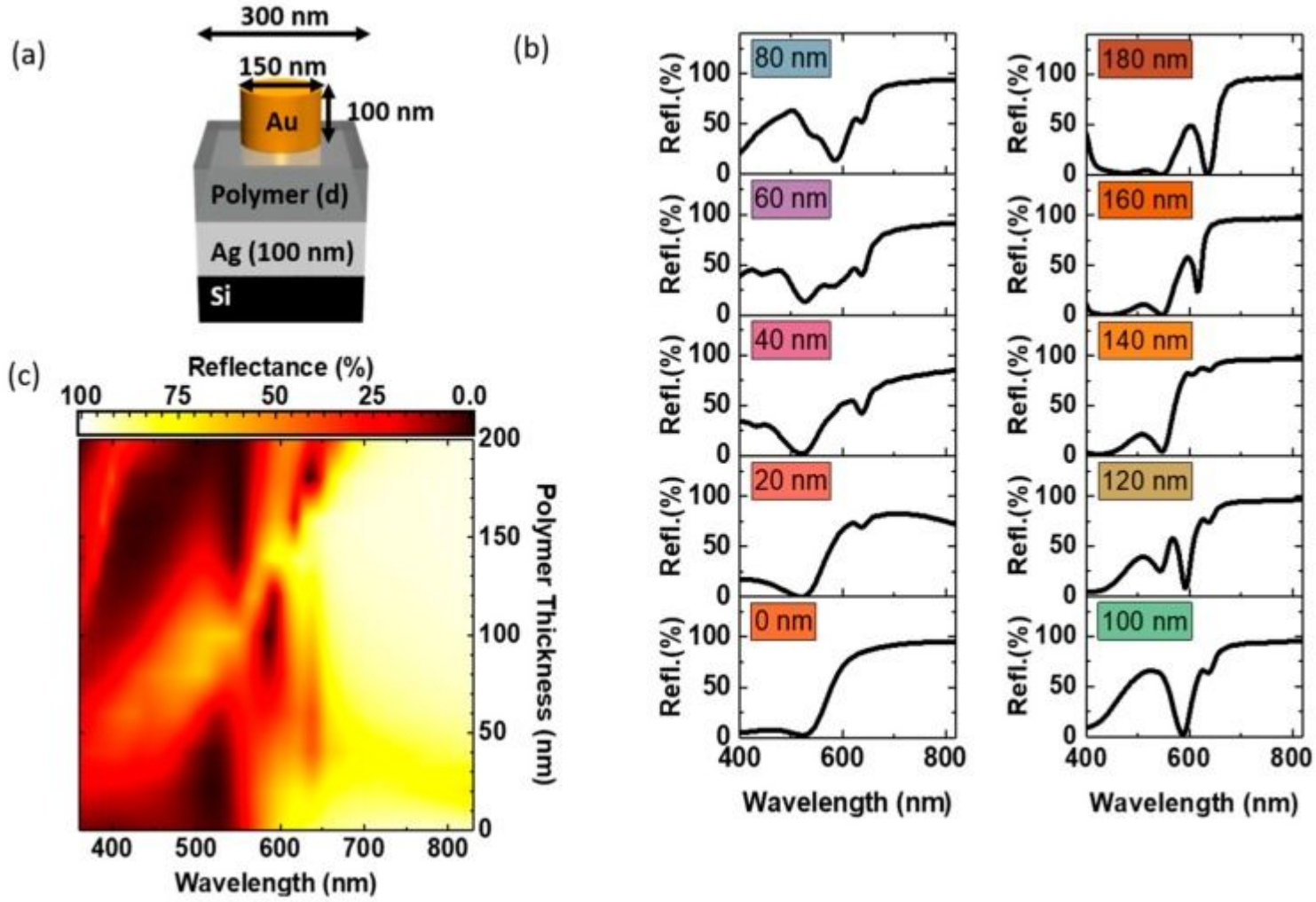




Teyssier J, Saenko SV, van der Marel D, Milinkovitch MC. Photonic crystals cause active colour change in chameleons. Nat Commun. 2015;6:6368. Published 2015 Mar 10. doi:10.1038/ncomms7368



Wilson K, Marocico CA, Pedrueza-Villalmanzo E, Smith C, Hrelescu C, Bradley AL.
Plasmonic Colour Printing by Light Trapping in Two-Metal Nanostructures.
Nanomaterials (Basel). 2019 Jul 1;9(7):963.



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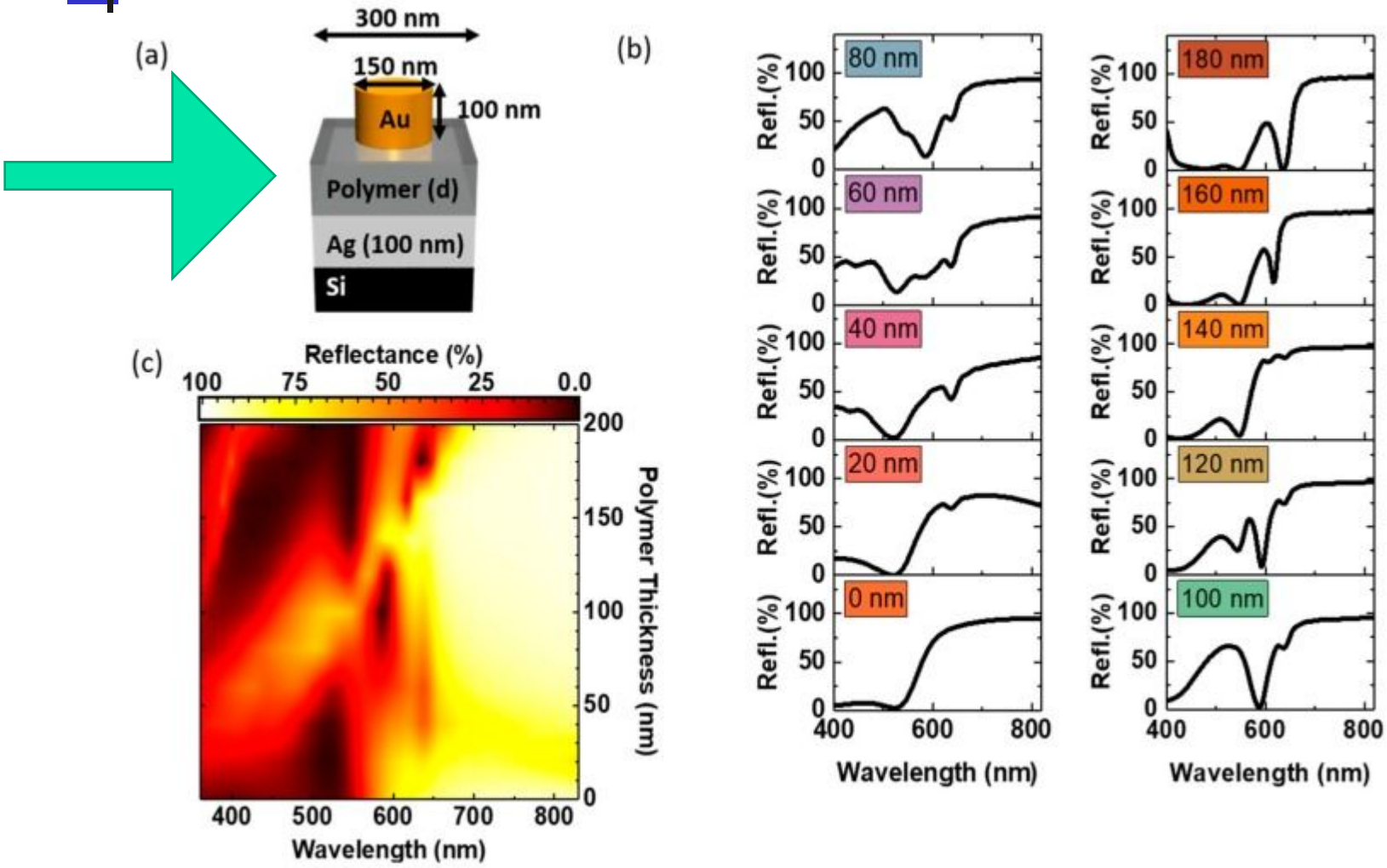

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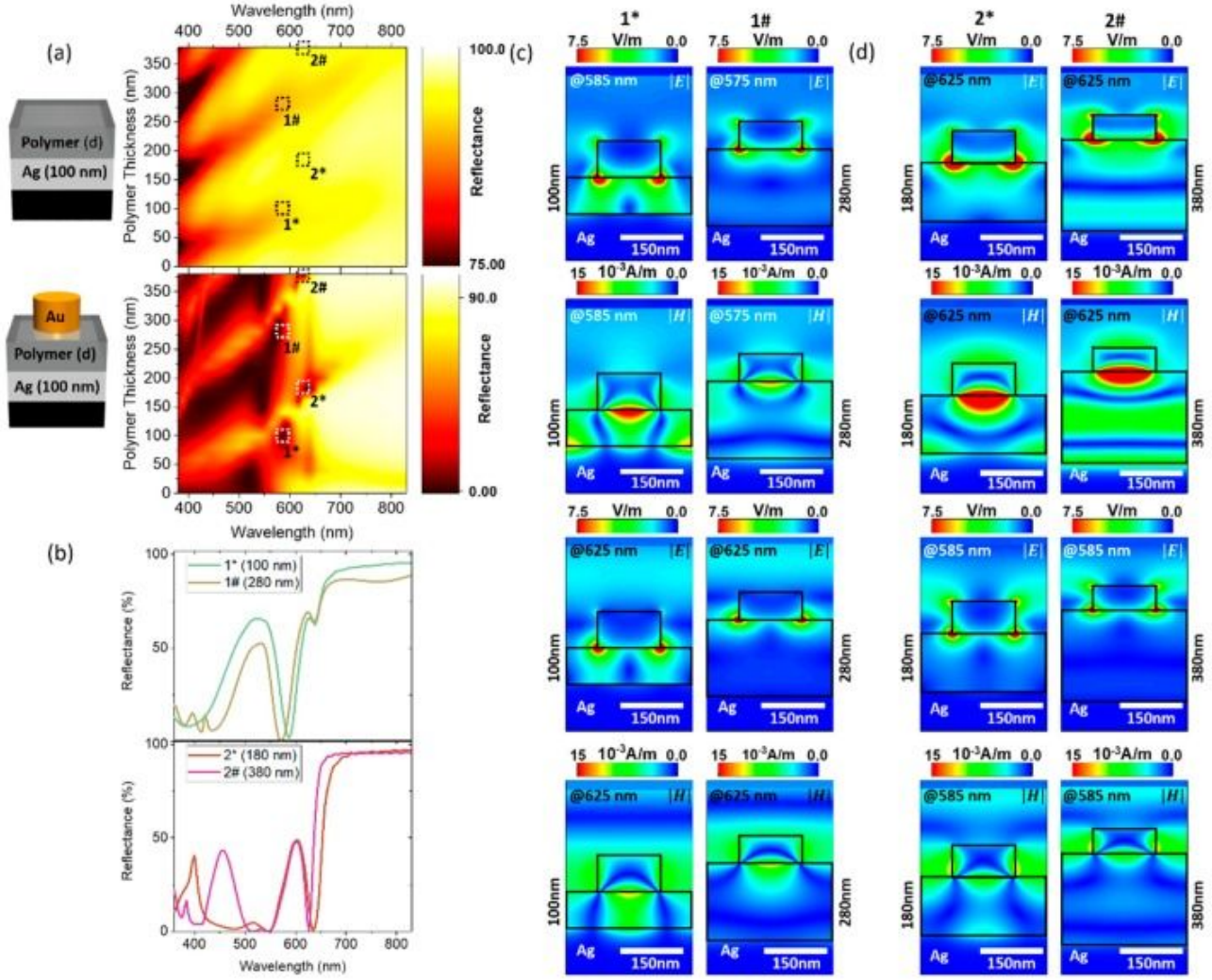
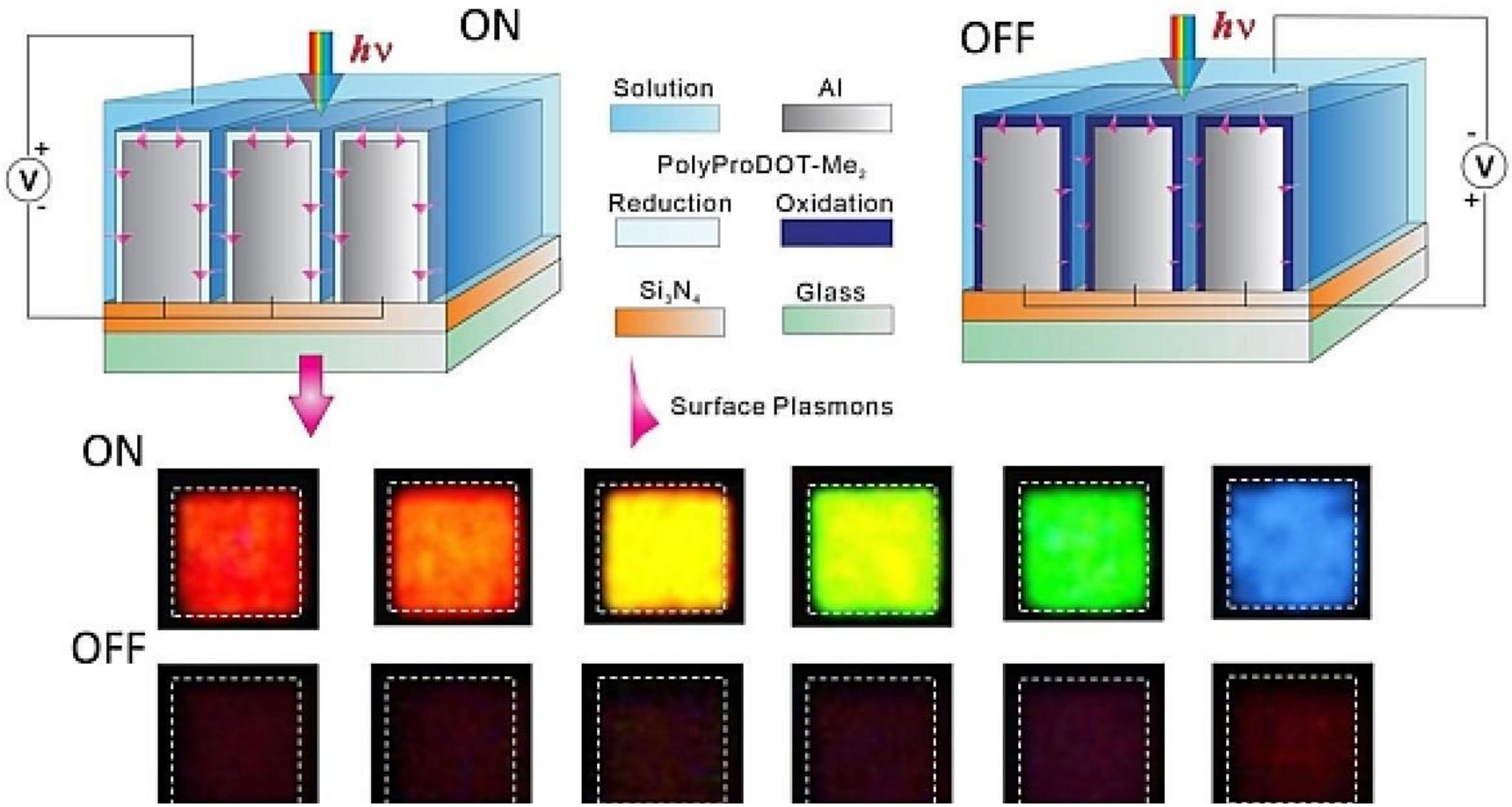
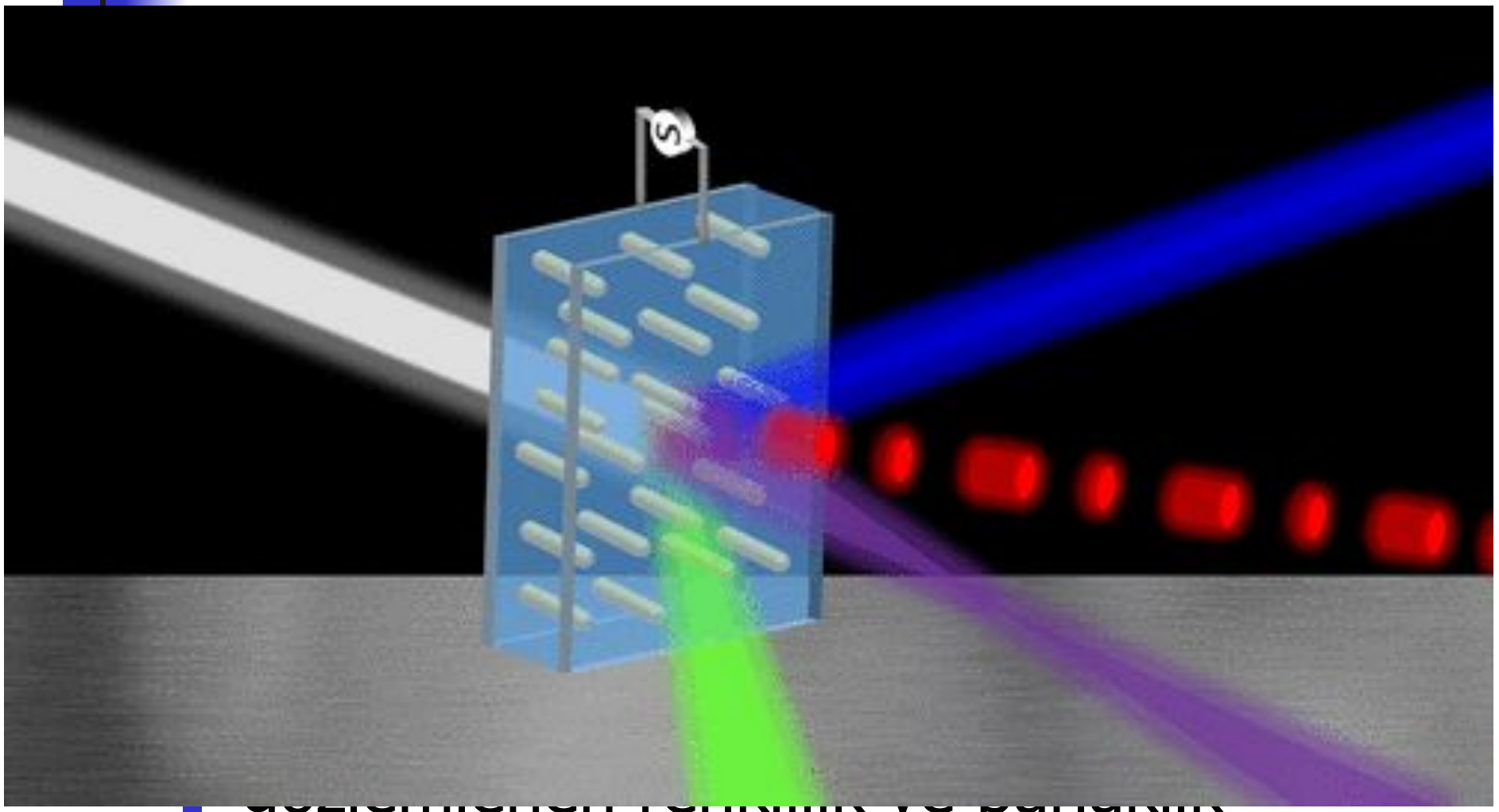


Elektronik kağıt



- Nano Lett.
- Musée Marmottan Monet/Giraudon/Bridgeman Images'ın izniyle araştırmacılar tarafından uyarlanmış orijinal görüntü:
- Claude Monet'in Impression, Sunrise (üstte)
- mikro ölçekli bir reprodüksiyonu (altta),

Greybush NJ, Charipar K, Geldmeier JA, Bauman SJ, Johns P, Naciri J, Charipar N, Park K, Vaia RA, Fontana J.
Dynamic Plasmonic Pixels.
ACS Nano. 2019 Apr 23;13(4):3875-3883.



- gözlemlenen renklilik ve parlaklık

Plazmonik sistemler
Likit kristaller

- Genelde çevresindeki mevcut ışığı kullanır.
- Ek aydınlatma yapılmadan da (ışık olarak) renk oluşturur.

- Çevresinde daha az ışık (aydınlatma) kirliliği oluşur
- > algılama daha iyi olur.

- Farklı özellikler ile kombine edilebilir. (polarize v.s.)

- Eş zamanlı iki ya da daha fazla renk oluşturulabilir.