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Rosemont

Illinois
3th to 5th June, 2019

TRACK ADVANCES II RESEARCH:

Treatments optimizing performance

Donald E.Stephens
Convention Center

“Nanostructure of the anodic porous anodic oxide advance in surface engineering “

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ABSTRACT

- Numerous metals are subjected to the anodic oxidation .Several physico-chemical effects and properties in the solid state involve nanoscale interactions between adjacent materials and morphologies.
- As a results one can obtain amorphous barrier-type oxide, crystalline barrier-type oxide or amorphous nanoporous oxide.
- Currently highly-ordered nanoporous anodic aluminium oxide (AAO).Arrays of binary nanostructures can generate intimate interactions between different sub-components, but fabricating binary nanostructures is challenging.
- Here, we propose a concept to achieve diverse binary nanostructure arrays with high degrees of controllability for each of the sub-components ,including material dimension and morphology.
- This binary nanostructuring concept originates with a distinctive binary-pore anodized aluminium oxide template, that includes two dissimilar sets of pores in one matrix, where the openings of the two sets of pores are toward opposite side of the template

- Using the same growth mechanism, the binary-pore templatecan be extended to multi-pore templates with more geometrical options.

- Me also present photo-electrodes, and plasmonic devices made with our binary nanostructure arrays sing different combination of materials and morphologies, and demonstrate superior performances compared to their simple components counterparts.

- Is obtained with various electrolytes to form nanostructures with a wide range of geometrical features. It allows applications for this material as a template fro nanofabrication of variety of nanowires, nanotubes and nanodots.

- Nanoporous anodic alumina (NAA). These ordered pores import with unique optical and electrochemical propierties,this provides detailed fundamental of engineering techniques and recent advances in development of NAA based

  engineering technologies.

Key words:

- Nanostructures porous alumina AAO membranes
- Porous alumina AAO membranes are widely used for fabrication of various nanostructures and nano-devices
- Nanoporus anodic alumina NAA
- Silanization of hydroxylated AAO
- Showing fabrication of AAO substrate with nanoparticles and nanorods
- AAO membrane used as a catalytic membrane
- Medical process histological examination of tissue that was exposed to the capsule, and optical micrograph representing te development of neural hubs on AAO. Of single neuroblastoma cells grown on different types of AAO. Normalized release of glucose unencapsulated control.
- Click chesmistry mechanism structures for pharmaceutical,industrial and medical areas
- Drug delivery

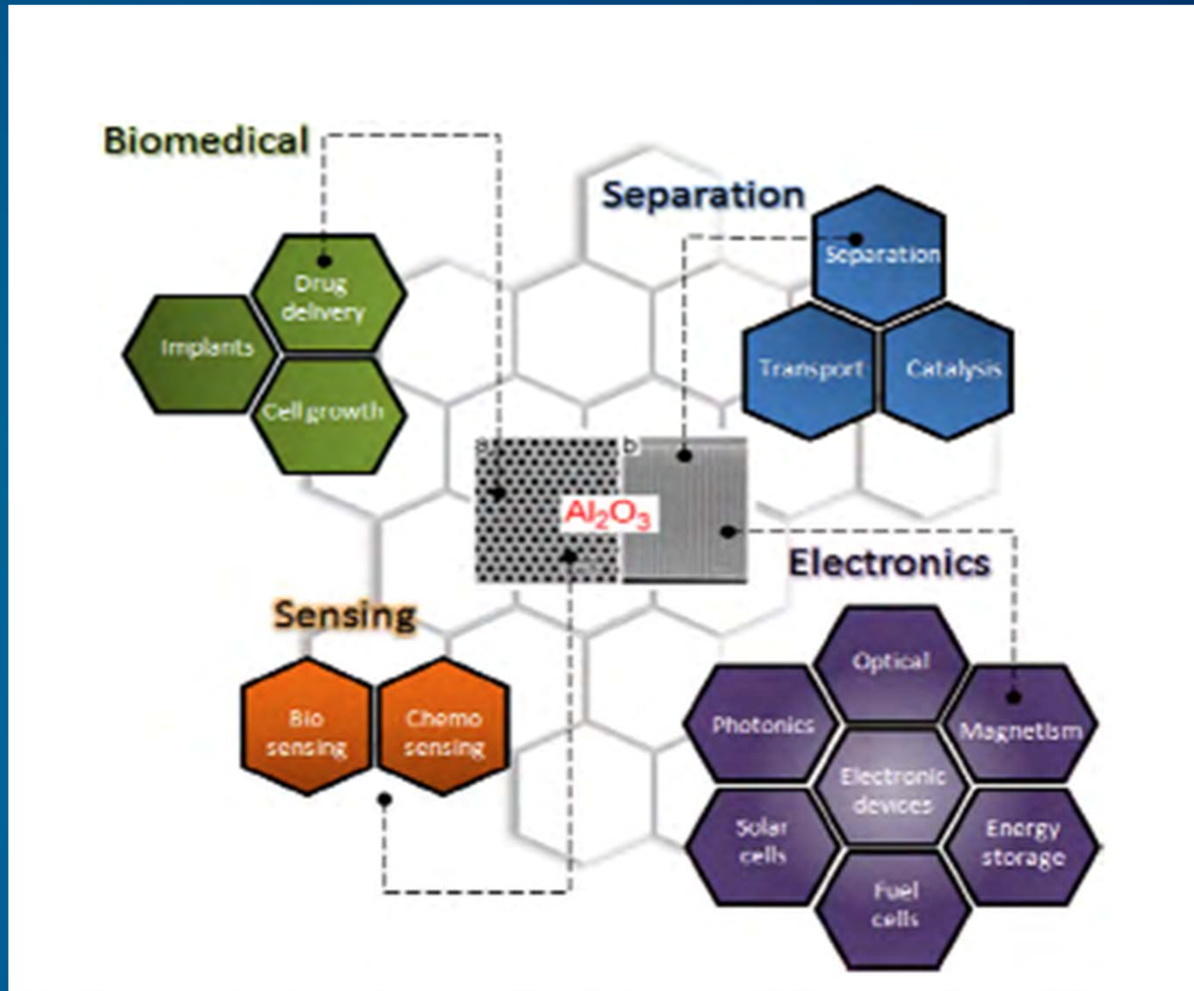

Fig. 1. Scheme showing the typical AAO structure and the major applications for this nanostructured material.

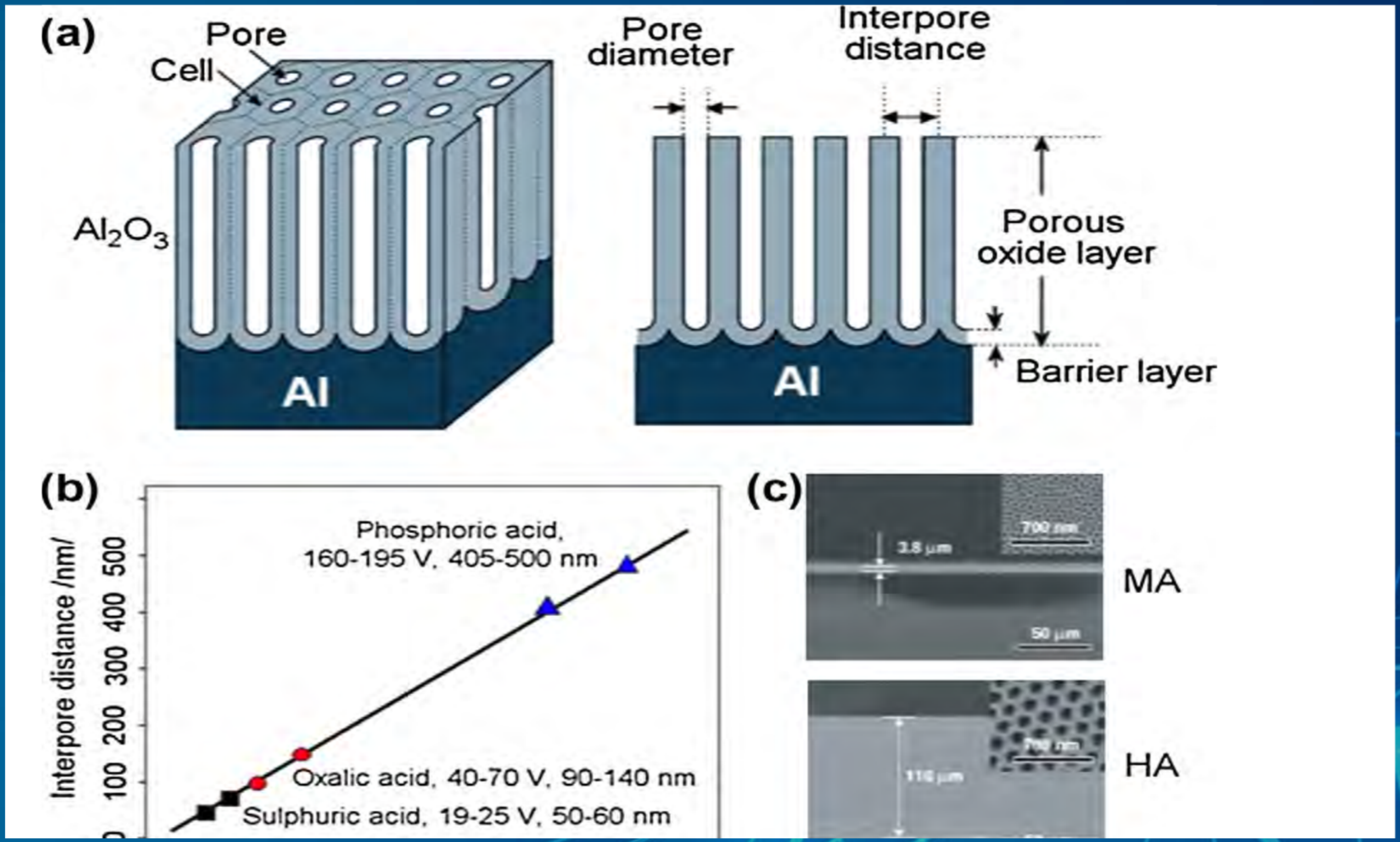

Fig. 2. (a) Schematic drawing of AAO structure prepared by electrochemical anodization of Al. (b) Summary of self-ordering voltage and corresponding interpore distance of AAO produced within three well-known regimes of electrolytes (sulfuric, oxalic and phosphoric). (c) (Top) SEM cross-sectional view of AAO membrane formed by MA (0.3 M H2C2O4, 1 °C, 40 V) and (bottom) by HA (at 140 V) for 2 h (insets: SEM top view of pore structures).

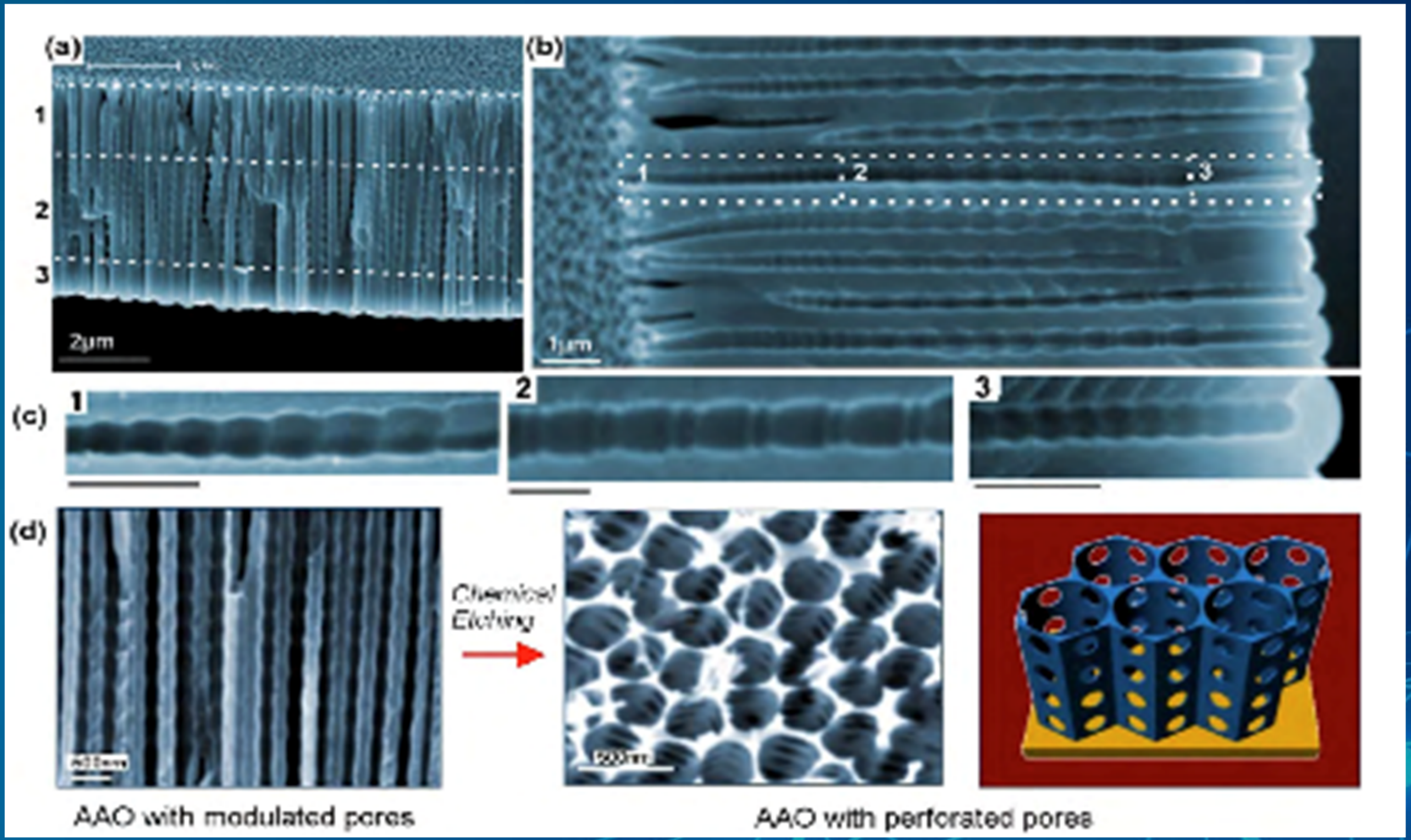

Fig. 3(Top): (a–c) SEM image of AAO with multilayered pore architectures with different pore shapes and structural modulation fabricated by multiple cyclic anodization in 0.1 M phosphoric acid with three successive galvanostatic anodization steps by three different cyclic signals. (d) AAO with periodically perforated pores (nanopores with nanoholes) by chemical etching. Adapted with permission from Ref. [78].

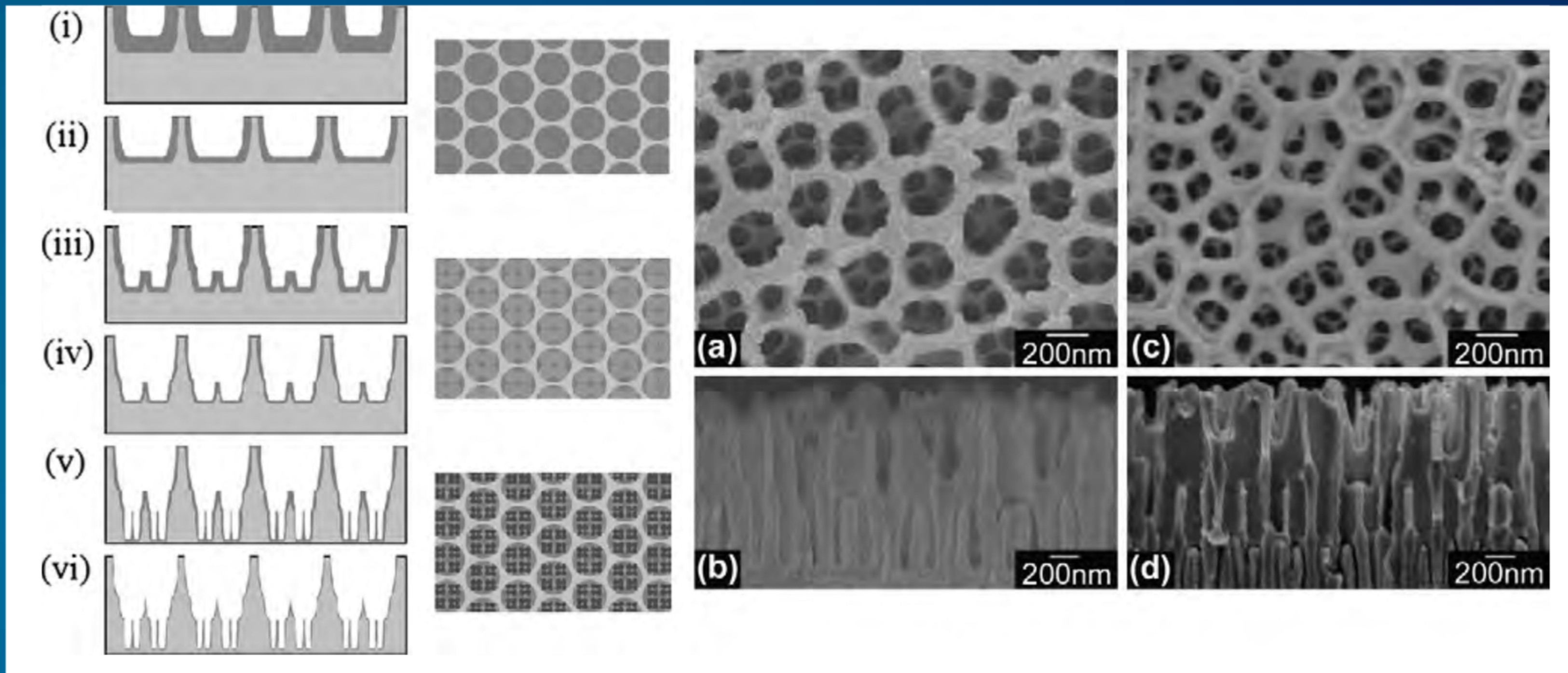

Fig.4. (Left): Schematic of the sequential fabrication steps of three-tiered branched AAO. (i and ii) First step, first-tier pore anodization and thinning of barrier layer. (iii and iv) Second step, second tier formation at reduced potential followed by thinning of barrier layer. (v and vi) Third step, formation of third-tiered pores at further reduced anodization potential and final pore widening and (middle) corresponding top views of all tiers. (Right): SEM microscopy of the resulting pore structures. (a and b) Top and cross-sectional views of a two-tiered branched AAO prepared by combined anodization in 0.3 M phosphoric acid (130 V) and 0.15 M oxalic acid (80 V) followed by thinning of the barrier layer. (c and d) Top and cross-sectional views of the three-tiered branched AAO prepared by combined anodization in 0.3 M phosphoric acid (130 V), 0.15 M oxalic acid (80 V) and 0.15 M oxalic acid (80 V) followed by thinning of the barrier layer. Adapted with permission from Ref. [70].

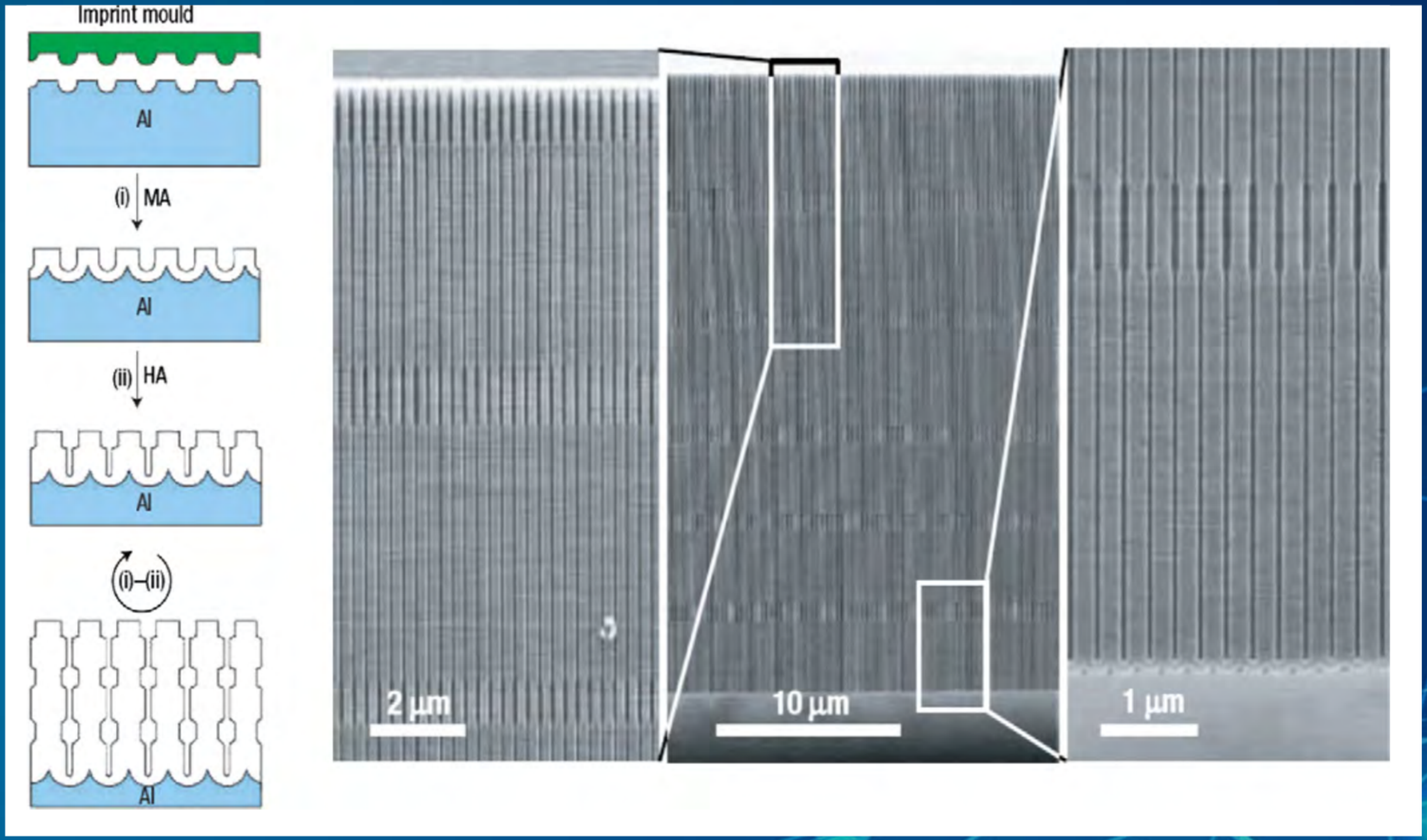

Fig.5. Long-range ordered AAO membranes with modulated pore diameters. (Left): Scheme for the fabrication of porous alumina with modulated pore diameters by a combination of MA and HA on a pre-patterned aluminium substrate. (Right): SEM micrographs showing the cross-section of the prepared AAO with modulated pore diameters. Magnified cross-section images of the top and bottom parts of the membrane are shown on both sides of the central image. Adapted with permission from Ref. [41].

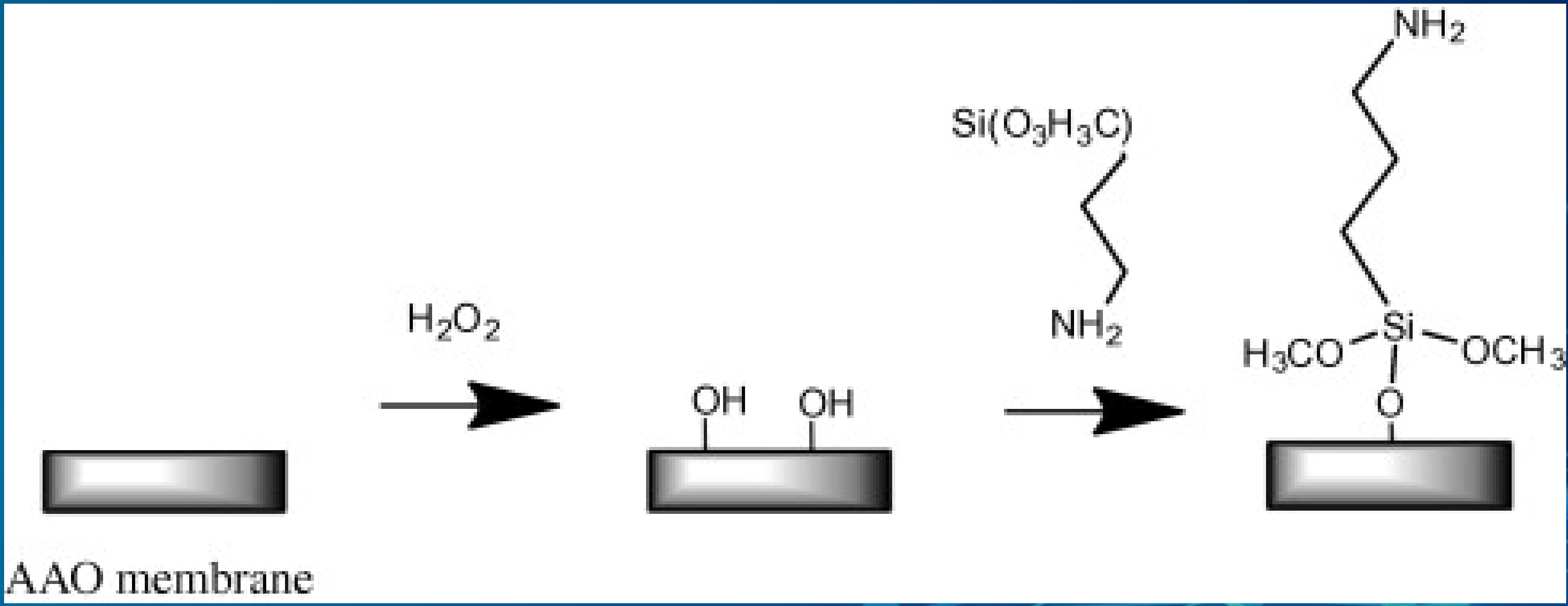

Fig 6. Common schematic route of silanization used for surface modification of AAO membranes.

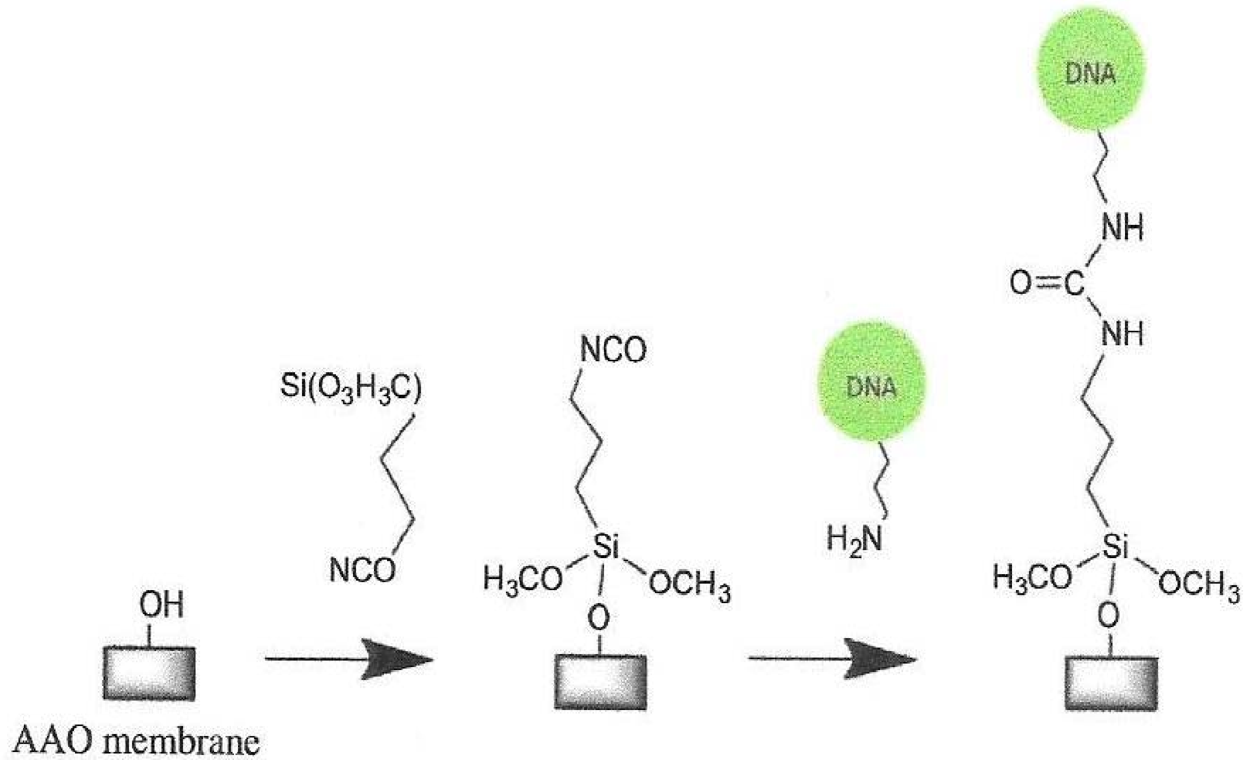

Fig 7. Silanization of hydrolylated AAO surface with isocyanatopropyl triethoxysilane and subsequent immobilization of amino-terminated DNA

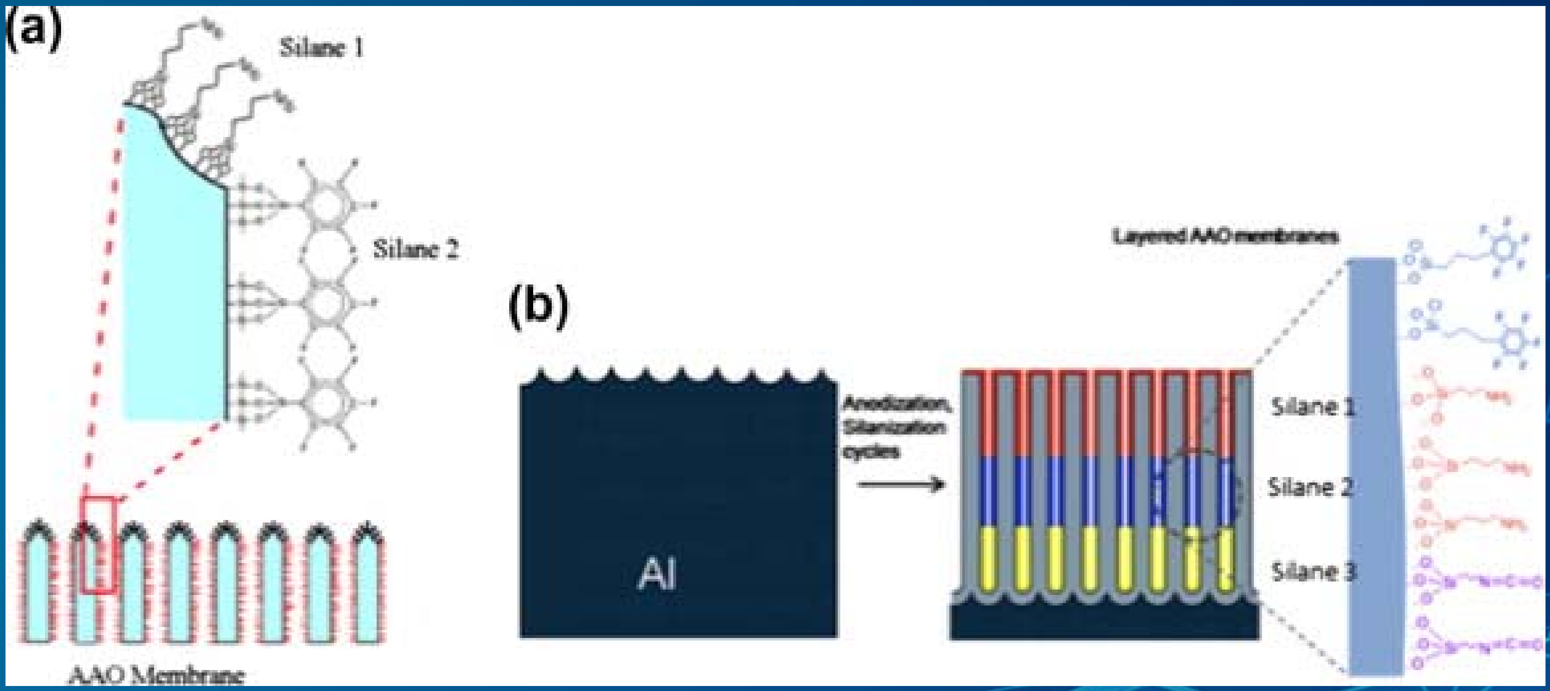

Fig 8. (a) Schematic of the opening of an AAO membrane wth different silane functionality on the very top of the membrane and the inside of the pores. (b) Schematic of anodization and silanization cycles to produce an AAO membrane with multiple silane layers.

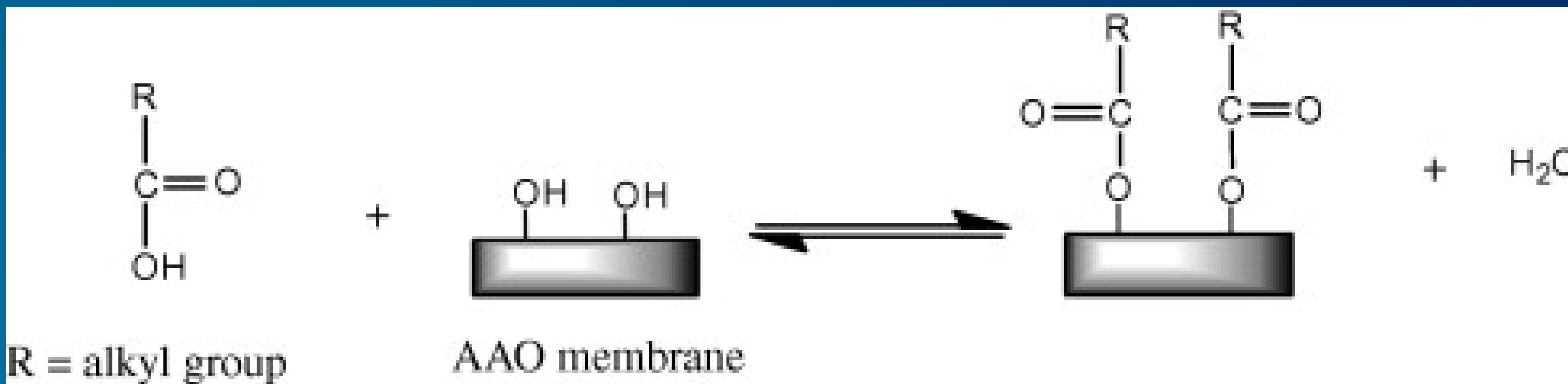

Fig 9 Reaction scheme of AAO membrane with n-alkanoic acid.

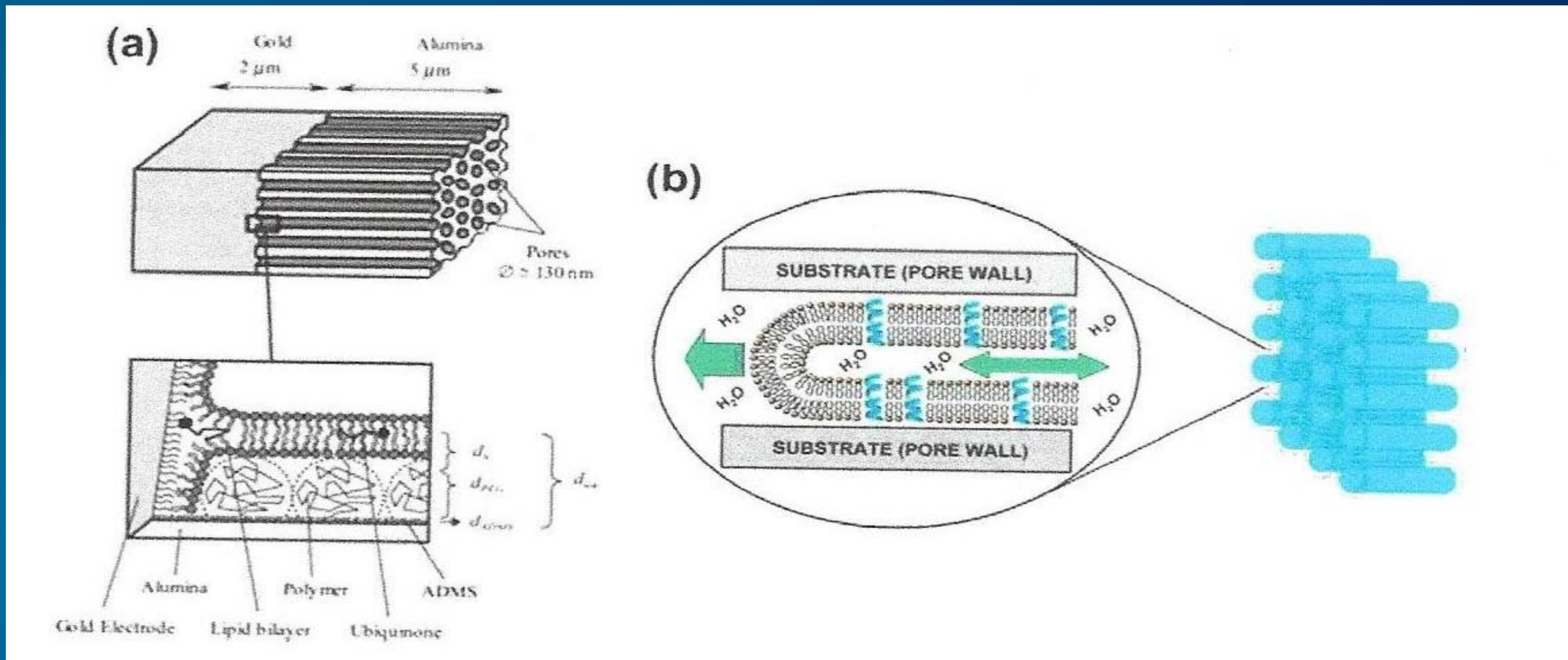

Fig 10. (a) Top: Structure of the AAO membrane with underlying Au layer as host for self-assembled lipid bilayer. Bottom: Enlarged view of pore bottom showing self-assembled lipid bilayer along the pore wall on polymer-functionalized surfaces. (b) Schematic of single lipid nanotubes (LNT's) propagating inside an AAO pore by capillary action

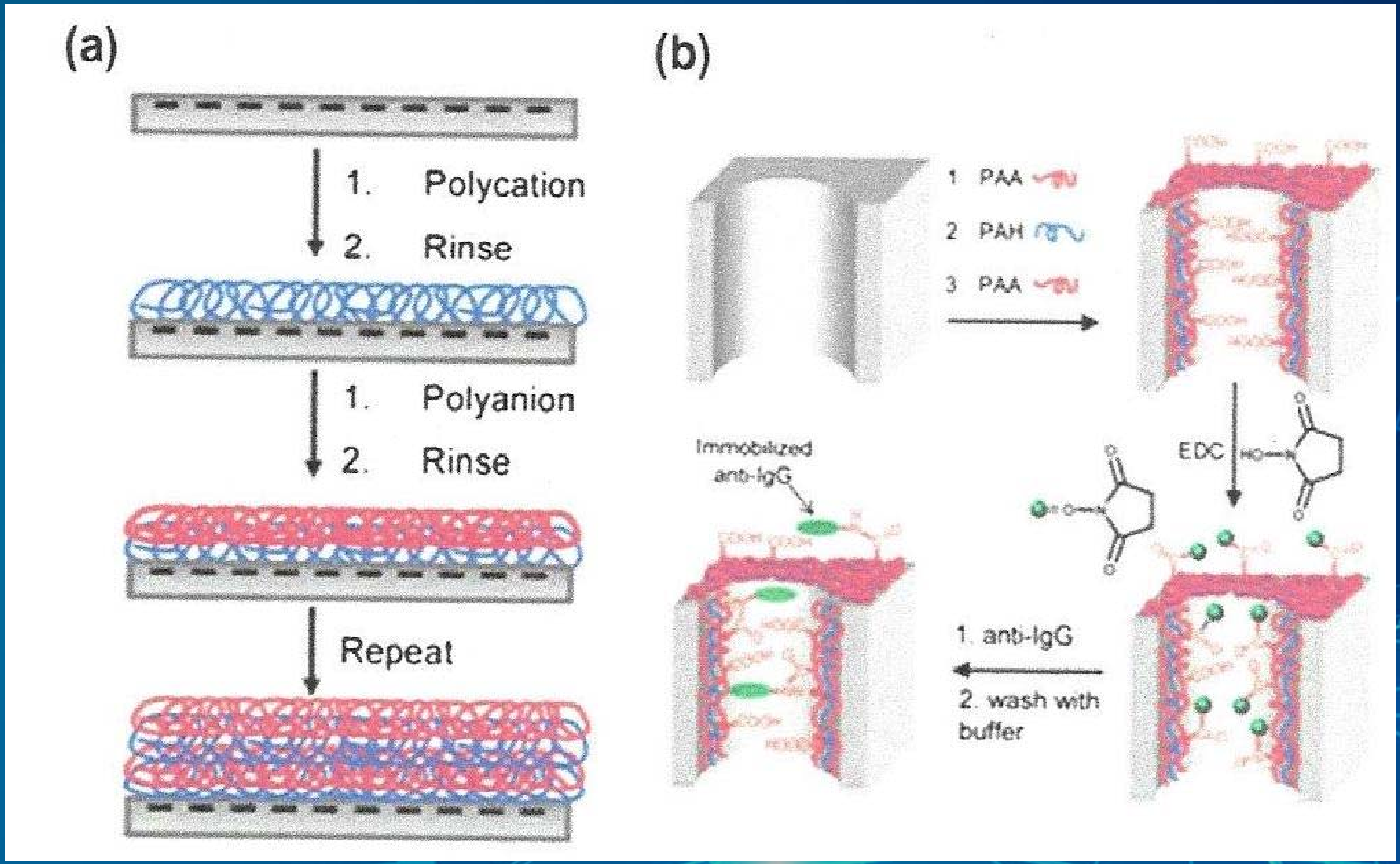

Fig 11 (a) Schematic of a pore of a AAO membrane modified by adsorption of two polyelectrolytes of opposing charge. (b) Schematic of a pore of AAO membrane modified by adsorption of polyelectrolytes followed by carbodiimide couplig of an antibody.

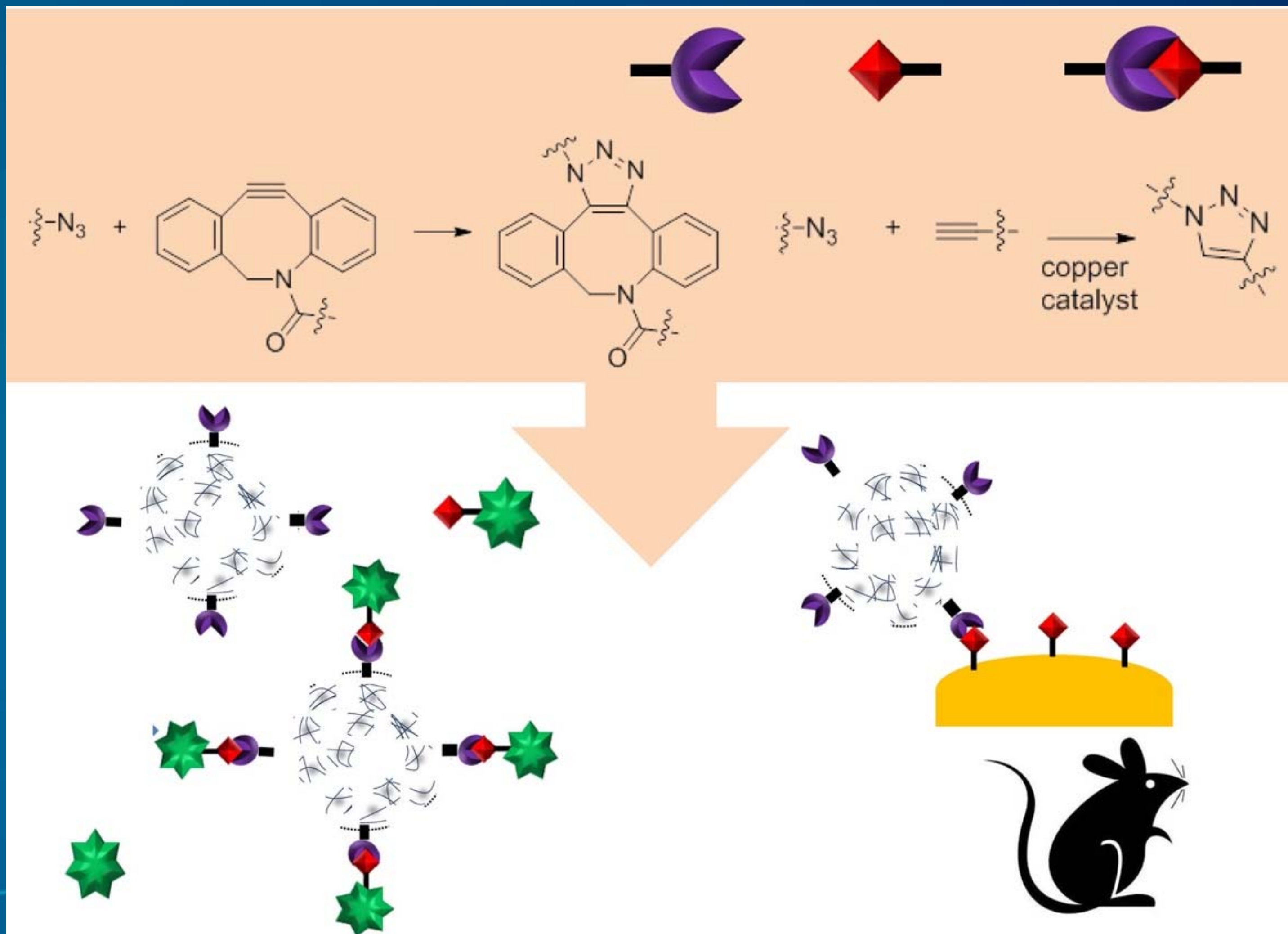

Fig 12. Illustration for the usage of click chemistry during nanoparticle synthesis and its targeting in vivo

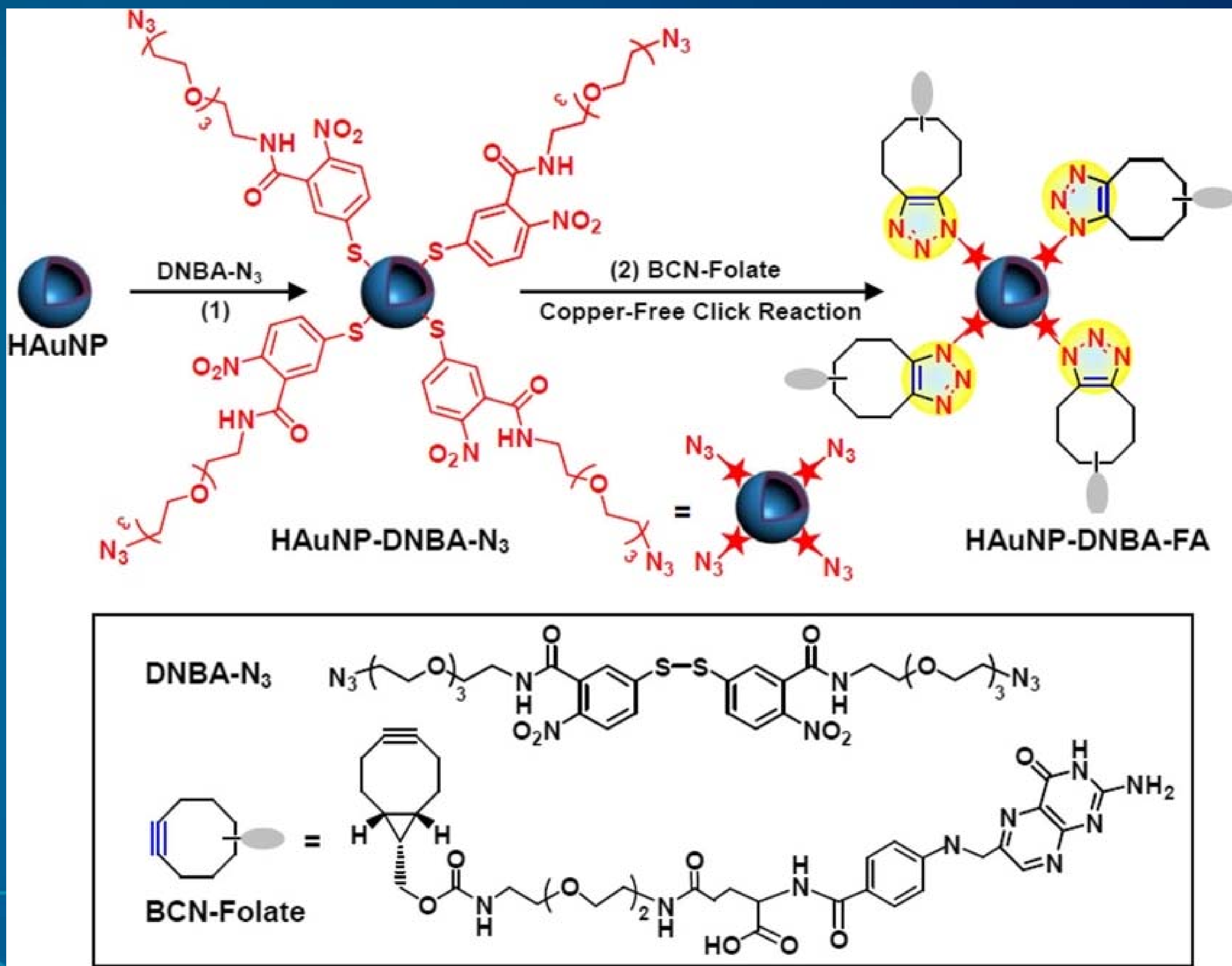

Fig 13. Modification of SERS nanoprobes with folate by copper-free click chemistry between azide and BCN for cancer cell imaging.

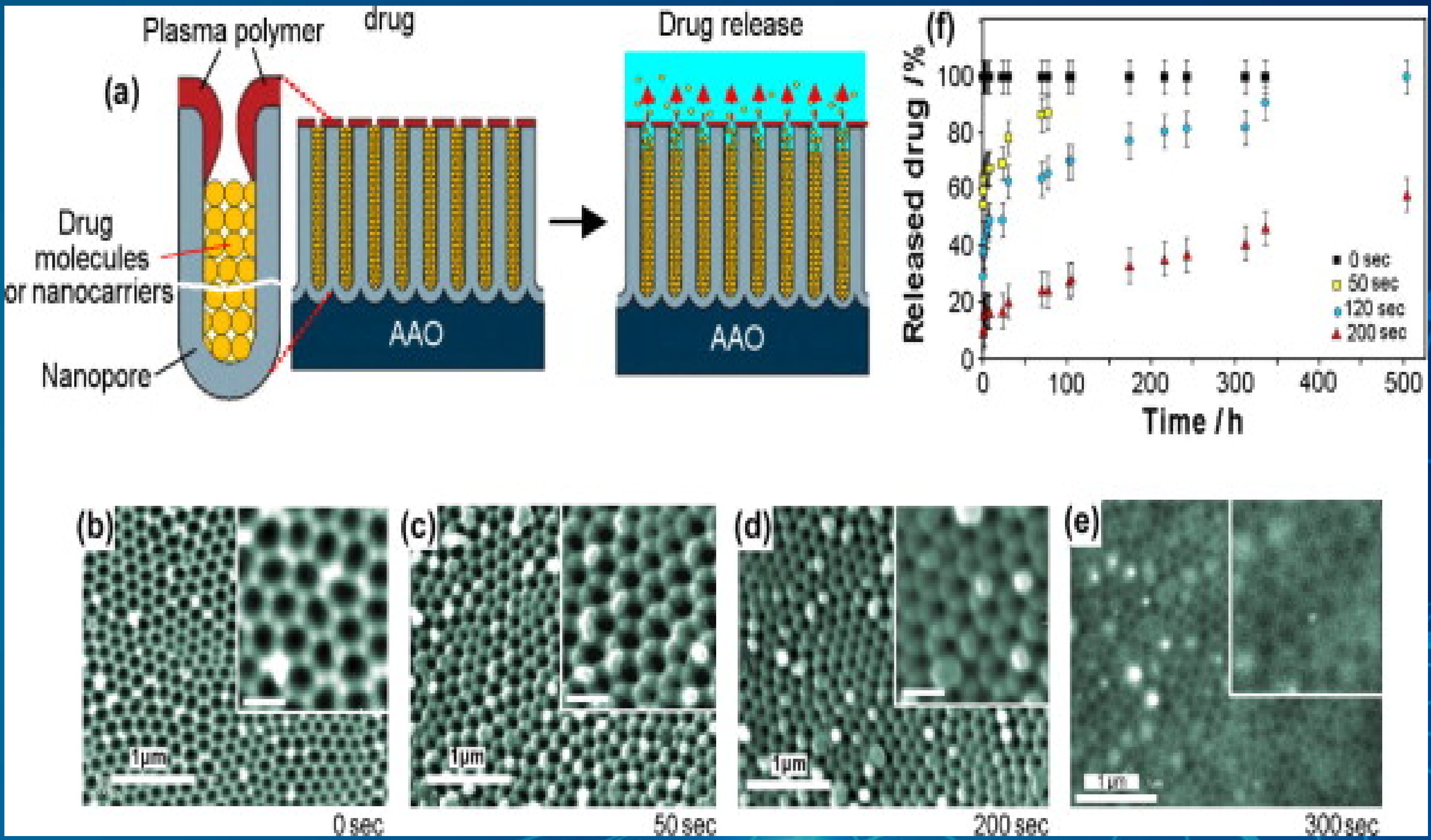

Fig 14. (a) Scheme of plasma polymer modification of AAO platform loaded with drug or drug nanocarriers (polymer micelles) to achieve controlled and extended drug release. (b) SEM images at the top surface of AAO porous layer modifier with allylamine plasma polymer using deposition times of (b) 0 s; (c) 50 s; (d) 200 s and (e) 300 s. Scale bart in inserts are 200 nm. (f) Controlled release of model drug vacomycin from plasma modified AAO during 500 h of drug realase.

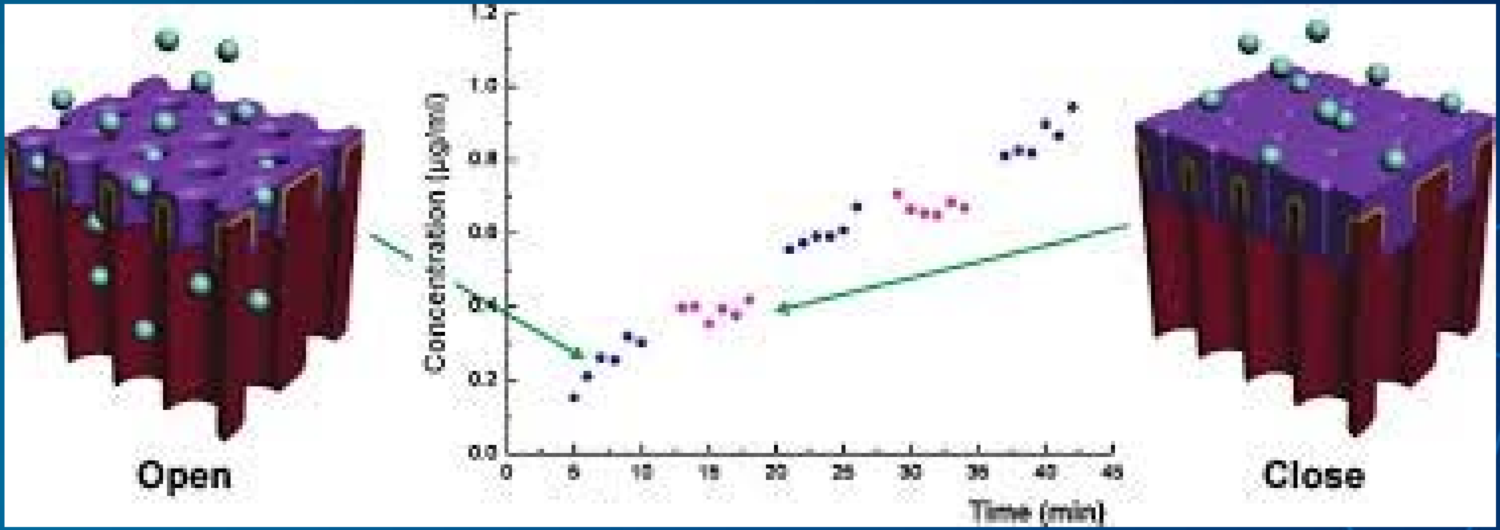

Fig 15. Schematic of electrically-responsive electropolymer-coted AAO membrane showing reversible change of pore size (and the drug release rate) between oxidation and reduction states.

SUMARY

- Over the past several years, significant progress, has been made, with regards to structural engineering and surface modification of nanoporous AAO material. Much of this progress has been application-driven. In this review ,we have drawn together innovative approaches on controlling and designing structural growth of AAO with different sizes, arrangements, structures ,geometries and pores architectures.

- Access to these structures is achieved by changing anodization conditions such as current ,voltage and type of electrolytes during electrochemically self ordering of AAO.

SUMARY

- An excellent consistency between experimental results and theoretical predictions of the interpore distance was observed for the highest studied anodizing time and the highest ethanol content in the anodizing electrolyte.
- We introduced recent application of click chemistry in nanoparticle research. During modification of biological ligands on the surface of nanoparticle, the intrinsic property and function of both ligands and nanoparticles need to be preserved
- Click chemistry in suitable for these purposes and used to attach ligands to nanoparticles easily

CONCLUSIONS

- Applications for this nanostructured material for biomedical-separation-sending and electronics
- Schematic of a pore of AAO membrane modified by adsorption on two polyelectrolytes of opposing charge
- Schematic of electrically-responsive electro-polymer-coated AAO membrane showing reversible change of pore size between oxidation and reduction states
- Silanization with AAO silane multilayers
- Polyelectrolytes of pores AAO membranes modified by adsorption of two polyelctrolytes coupling of an antibody
- Researchs ara also pushing the boundaries of molecular separationsusing AAOwith pores of controlled shape and size,internal surface modification and explore the effect of

CONCLUSIONS

- Of external parameters, such as ,Ph , flux concentration gradient and ionic strength.

- Fabrication of complex AAO nanostructures combined with even greater control over surface functionality is expected to lead to unique nanostructures and nanodevices with unprecedented functional properties for the next generation devices including the exploration of their application with a focus on a different research area ranging from medicine to material science and electronics

THANK YOU VERY MUCH FOR YOUR ATTENTION

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