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# Tailor-Made Anodic Aluminum Oxide Photonic Crystals for Photocatalytic Applications

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Anodic aluminum oxide (AAO) membranes feature self-organized, highly ordered cylindrical pores with distinct geometrical characteristics such as pore length and diameter, interpore distance, and barrier layer thickness. Modifying the electrochemical anodization parameters and applying pulse-like anodization profiles tailors the pore morphology, specifically the diameter, from straight to periodically modulated structures such as distributed Bragg reflectors or gradient index filters. Accordingly, the membranes act as photonic crystals (PCs) and exhibit photonic stopbands in which light propagation is forbidden. Incoming photons of wavelengths near the stopband edges are slowed down within the tailored structure due to the so-called slow photon effect. This phenomenon results in an increased interaction probability of the photons with the PC material, hence, making such structures very attractive for photocatalytic applications. The photocatalytic performance of AAO-PCs can be further enhanced by functionalizing the surface with photocatalytically active materials (e.g. $TiO_2$, ZnO, $WO_3$) or tuning the photonic stopband position of the AAO by adapting the pore morphology. Herein, surface modifications of AAO-PCs by atomic layer deposition (ALD)—a deposition method based on sequential, self-limiting gas-solid surface reaction—are conducted and the degradation of methylene blue is studied to assess the photocatalytic properties of these PC structures. Optimizing and combining the different preparation strategies to further improve the photocatalytic efficiency and to tune the wavelength selectivity of AAO-PCs could expand their utilization as tailor-made photocatalysts.

**Primary author:** HEDRICH, Carina (Center for Hybrid Nanostructures (CHyN), Universität Hamburg)

**Co-authors:** LIM, Siew Yee (School of Chemical Engineering and Advanced Materials/ Institute for Photonics and Advanced Sensing (IPAS)/ ARC Centre of Excellence for Nanoscale BioPhotonics (CNBP), The University of Adelaide); SANTOS, Abel (School of Chemical Engineering and Advanced Materials/ Institute for Photonics and Advanced Sensing (IPAS)/ ARC Centre of Excellence for Nanoscale BioPhotonics (CNBP), The University of Adelaide); Prof. KOZIEJ, Dorota (Center for Hybrid Nanostructures (CHyN), Universität Hamburg); Prof. BLICK, Robert H. (Center for Hybrid Nanostructures (CHyN), Universität Hamburg); ZIEROLD, Robert (Center for Hybrid Nanostructures (CHyN), Universität Hamburg)

**Presenters:** HEDRICH, Carina (Center for Hybrid Nanostructures (CHyN), Universität Hamburg); HEDRICH, Carina (Universität Hamburg)

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