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## Plasma Enabled Fabrication and Applications of Nanometamaterials and Porous Alumina in Electric Propulsion

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Engineering new class of hybrid materials that can be used as ultra-sensitive sensors for electric propulsion, gas detection, air contamination control is critical to meet the global challenges of the environment conservation and efficient use of energy and mineral resources, especially for point-of-use applications. Template-assisted synthesis is an elegant approach for achieving highly-controllable growth of the arrays of various nanometamaterials. Anodic aluminum oxide (AAO) membranes is one of the best template candidates to fabricate these promising materials such as arrays of carbon related or other noble metal nanotubes [1,2], and nanowires [3,4].

In this work we report on several examples for growing and functionalization of nanometamaterials by exposing highly-periodic (hexagonally-symmetrical), porous anodic aluminum oxide templates to a low-temperature plasma. Characterization using TEM, SEM, and EDX techniques have shown different nanostructures have been fabricated successfully and novel applications such as in gas sensing [5] and plasmonic effects [6] have been demonstrated. With plasma, our environmentally-friendly process is simple, fast and does not involve any pre-treatment for the samples. This novel fabrication and functionalization technique constitutes another interesting application of alumina templates to different nanometamaterials growth.

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