Contribution ID: **190** Type: **Poster**

Fabrication and characterization of novel iron oxide aeromaterial

Wednesday 9 July 2025 14:45 (15 minutes)

In this work, we report the fabrication of a novel aeromaterial based on Fe_3O_4, synthesized via spray pyrolysis and drop infiltration techniques. The process involves the deposition of Fe_3O_4 onto sacrificial ZnO microtetrapod templates. The precursor solution consisted of 0.15 M $FeCl_3$ dissolved in ethanol. For the spray pyrolysis approach, a custom-built setup was used, with the substrate maintained at 480 ℃ and the deposition time being 3 minutes, yielding Fe_3O_4 thin films with an approximate thickness of 400 nm. In the drop infiltration method, 150 µL of precursor solution was droped on the ZnO microtetrapods substrate at a rate of one drop per second, at room temperature. The samples were subsequently annealed at 500 ℃ for one hour in air in order to improve the material's crystallinity and eliminate residual chlorine. The ultraporous structure of Fe_3O_4 was achieved by selectively etching the ZnO templates using 0.1 M citric acid. The final three-dimensional architecture was obtained through a controlled drying process in a lyophilizer at –55 ℃ for 8 hours. The structural characterization of the material using XRD showed the presence of both Fe3O4 and ZnFe2O4 mixed phases. The photoelectrical characterization at 150 K and 300 K and excitation using an Nd:YAG laser (355 nm) has shown the remanent photoconductivity, with a more pronounced effect at lower temperatures.

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Session Classification: Poster Session 1

Track Classification: S03 –Condensed matter, Materials and Applied Physics