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High-resolution confocal Raman microscopy analysis of the transparent hematite films prepared on fluorine-doped tin oxide coated glass substrates by spray pyrolysis

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Hematite (Fe2O3) is a promising material that is being studied immensely for its application in solar water splitting. It has attractive properties such as a narrow bandgap that allows for absorption of visible light, earth-abundant and is an easily processable photocatalytic material. In this study, we report hematite thin films prepared by spray pyrolysis on fluorine-doped tin oxide (FTO) coated glass substrates; it has been shown in literature that films prepared by ultrasonic spray pyrolysis allow for better light harvesting than those prepared by conventional spray pyrolysis. Amongst other characterization techniques, Raman micro-spectroscopy is a preferred method for hematite analysis since it is non-destructive. This work demonstrates the characterization of the as-prepared hematite thin films using the confocal Raman technique (with three different laser sources, i.e. 488, 532 and 633 nm) combined with an integrated atomic force microscopy (AFM) and force-distance curves measurements. Raman imaging/spectroscopy confirmed the characteristic Raman spectrum of the hematite. In addition, the less rough surface of the films seen from the Raman optical microscope images as well as AFM 3D surface images confirmed the uniform and conformal coverage across the substrate with surface roughness in the order of <10 nm. The force-distance curves (approach and retract) have shown an average adhesion force of about 10.4 nN for hematite on FTO substrates. Moreover, from Raman depth profiles the thicknesses of the films were estimated.

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