Novel Formulation of Highly Stable Metal-Organic Inks for Printed Electronic Applications

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The goal of this project was to formulate highly stable metal-organic ink for application in the printable electronics industry. The production of metallic inks with metal-organic complexes will lower the production cost, make solutions simpler to fabricate and crystalize, and allow for scalable, roll-to- roll production of custom electronics. Iron(III) Acetylacetonate [$Fe(acac)_3$] was dissolved in twelve solvents based on polarity (nonpolar, aprotic polar, and protic polar) and functional groups to determine the solubility limit of $Fe(acac)_3$ in each solvent. The solubility limit tests had determined that aprotic polar solvents, such as dibenzyl ether, dimethyl carbonate, and butanone most effectively dissolved $Fe(acac)_3$. Solvents also had to meet various rheological property, physical property, and toxicity criteria. Top performing solvents in each of these categories were evaluated for use in inkjet printing. The best solvent from this evaluation was dibenzyl ether, with a solubility limit of 12.44% by weight. The printed ink was then cured through the use of a PulseForge, a high intensity photonic curing system. Upon treatment in the PulseForge, dibenzyl ether containing inks produced a conductive film but failed to retain print quality, therefore the formulated ink was not optimal as a base for printing electronics. Future research will be conducted to find new solvents, such as N-Methyl- 2-pyrrolidone, that are more optimal for printed electronic applications. This research has been an important development in the printed electronics industry, and the methods developed here will allow for the production of a vast array of metal-organic inks, each with unique properties.

Awards Won:

University of Arizona: Tuition Scholarship Award