Adhesion of Metal Thin Films to Polymeric Substrates

Overview

JMU inventors have developed a method of adhering a thin gold (Au) film on polymeric substrates. The method could have broad applications in a variety of technologies including polymer microdevices, microfluidics, sensors, biomedical devices, flat panel displays, photovoltaic devices, and micro total analysis systems (µ-TAS or “lab-on-a-chip”), and the aerospace, battery, semiconductor and automotive industry.

The advantages of polymeric substrates include improved manufacturability, lower processing temperatures and overall thermal budget, and lower cost of manufacture. A critical processing step needed for devices employing polymeric substrates includes the deposition of metal thin films in the fabrication of electrodes and interconnecting wires in a variety of devices including sensors, catalysts, photonics, polymer electronics, µ-TAS, and microelectrodes. Vapor deposited gold (Au) thin films are widely used in many of these technologies.

Unfortunately, Au is a relatively inert metal that has notoriously poor adhesion to polymers. Techniques which have been used to improve polymer/Au thin-film adhesion include chemical etching, corona discharge, plasma treatment, and irradiation. However, most techniques have met with limited success in significantly improving the Au thin film adhesion onto many polymeric substrates. A major drawback of the aforementioned techniques is that they have the potential to damage the surface of the substrate.

This invention involves improving the adhesion of metal films deposited onto polymeric substrates by exposing the polymeric substrate to at least one non-complexing solvent in addition to metal deposition. The metal deposition for methods of the present technology can include depositing a first layer of metal, such as a layer of Cr, as an adhesion layer onto the polymeric substrate prior to depositing a second layer of metal, such as Au, or can include depositing a single metal film directly onto the polymeric substrate.

Innovation At-a-Glance

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Technology Readiness: Early Stage
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Tech Transfer and Business Model

JMI is interested in identifying an existing company or entrepreneur to commercialize the technology. The licensee would need to conduct further research and development to prepare the technology for use in commercial environments. A small company or entrepreneur could further develop the technology, possibly using SBIR or STTR funding, and then sublicense it to multiple companies developing polymer microdevices, microfluidics, sensors, biomedical devices, flat panel display and photovoltaic devices.

Market and Competition

The technology would have applications in a variety of markets, and would provide a disruptive approach to methods currently provided by the thin-film deposition market. A March 2011 Global Market Analysts, Inc. report says the thin-film deposition equipment market is expected to reach nearly $17 billion by 2015. Thin-film raw materials account for $10 billion or more. Thin-film deposition technology is a broad industrial segment that is typically divided into physical vapor deposition (PVD) and chemical vapor deposition (CVD).