Design of a Radio-Frequency Facing-Target Sputtering System
for Low-Damage Thin Film Deposition

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Thin film devices are becoming increasingly important in the electronic semiconductor industry. For example, nanostructured donor/acceptor photovoltaics utilizing small molecule organics, conjugated polymers and/or quantum dots have the potential to provide our planet with a vast supply of clean, cheap energy\(^1\). Organic light-emitting diodes (OLEDs) provide many advantages for the development of flat panel displays (FPDs) because of their high luminescence, high efficiency, wide color range, easy fabrication processes, and flexibility\(^2\). Moreover, thin film transistors (TFTs) are proving advantageous in the production of OLED backplanes\(^3\).

Reliable thin film deposition processes are necessary for the continued improvement of these technologies. Sputter deposition is an example of one of these processes, with advantages such as high step coverage, good film uniformity, high deposition rates, and capacity for growing multi-element films. However, the fabrication of many semiconductor devices involves deposition onto a substrate previously coated with an organic thin film. Energetic particles in the sputtering plasma have been shown to cause critical damage to these organic layers on substrates during sputter deposition\(^4\). This damage must be reduced in order to fabricate high quality organic semiconductor devices.

For this purpose we have designed a radio-frequency facing-target magnetron sputtering system. The facing-target configuration has been shown to effectively confine the sputtering plasma below the substrates, thereby protecting previously deposited organic layers. Our design also features high strength magnets positioned above the sputter guns to create a high magnitude magnetic field near the substrates for further protection from high energy electrons and ions. Radio frequency excitation of the sputtering plasma will allow for the deposition of insulating materials.

CAD designs for the sputtering system were created in SolidWorks, and Finite Element Analysis (FEA) was performed using Maxwell 3D.

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