Abstract Submitted
for the 4CF13 Meeting of
The American Physical Society

The low-pressure, chemical vapor deposition of Si02 layers using CO2 as the oxygen source with applications to CNT-MEMS growth

KENNETH HINTON, Brigham Young University — Deposited silica (SiO_2) has a number of applications for microfabricated structures, particularly those based on coating carbon nanotube forests. Members of our group have, for example, reported on the fabrication and use of SiO_2-coated carbon nanotube forests (CNT-MEMS) to prepare liquid chromatography plates of record efficiency. SiO_2 also has extremely low thermal conductivity and stiff, coated, carbon nanotube forests could be used as thermal barrier layers. We have examined two novel methods for the LPCVD of SiO_2 and oxygen-rich amorphous silicon. Both methods are based on the hypothesis that carbon dioxide could be used as the source of oxygen in preparing the material. In the case of oxygen-rich amorphous silicon (a-Si:O) we used silane as the silicon source, and the case of SiO_2 used dichlorosilane. We deposited the a-Si:O material at about 800K while the Si02 from SiH2Cl2 , was deposited at about 1000 K. Depositions were done at low pressure, about 200 millitorr for the a-SI:O and at about 1 to 4 Torr for the SiO_2. The substrates in all cases were three-inch single-crystal silicon wafers. We subsequently examined the deposited material using variable-angle, spectroscopic ellipsometry (VASE-John A. Woollam M 1000) for of thickness and optical constants and SEM structure and composition. The dichlorosilane deposition of SiO_2 suffered from vanishingly small deposition rates at very low pressures at 1000 K and the incorporation of "snow" into the films in the case of depositions done at higher pressures. We found little evidence of carbon incorporation.

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Date submitted: 22 Sep 2013 Electronic form version 1.4