Fast deposition of a-C:H : increasing quality with increasing growth rate

11:00 am **PS+BI-ThM9** **Fast Deposition of a-C:H: Increasing Quality with Increasing Growth Rate**, *J.W. Gielen, W.M. Kessels, A. de Graaf, J.L. Longueville, M.C. Sanden, D.C. Schram*, Eindhoven University of Technology, The Netherlands

An expanding thermal arc plasma is used to deposit amorphous hydrogenated carbon films. The thermal arc is operated in argon and the carbon containing gas C_2H_2 is injected downstream in the expanding plasma beam. The substrate can be biased separately by means of an RF bias. The substrate temperature can be controlled in the range -100 up to 250 °C. The ion energy can be controlled by a separate RF bias in the range 2 up to 100 eV. By means of arc current (Iarc = 25-90 A) and C_2H_2 flow variation (0.5-20 scc/s) films with different characteristics are deposited at different temperatures. Other plasma settings, chamber pressure and Ar flow were kept constant (at 0.2 mbar and 100 scc/s respectively). The plasma is characterized using Langmuir probe measurements and emission spectroscopy. The films are deposited on glass and silicon substrates, and in situ ellipsometry is used to determine the growth rate. The films are characterized using various techniques. ERDA and RBS are used to determine the carbon and hydrogen density. The bonding structure, refractive index, and band gap are obtained by UV/VIS transmission-reflection and infrared absorption measurements. The hardness and Young's modulus are measured by microindention measurements. It is observed that the quality in terms of hardness increases with growth rate (a maximum growth rate of 50 nm/s is achieved). From the emission spectroscopy in combination with the Langmuir probe measurements the dominant radical and ion fluxes are obtained. The temperature dependence and the dependence on ion energy indicate that the deposition is radical dominated, presumably the C_2H radical. The radical and ion fluxes are used as input parameters in the deposition model. The influence of ion energy and substrate temperature on hardness and other film properties is discussed.