Advanced Surface Engineering
Room: Hall D - Session SE-TuP

Advanced Surface Engineering Poster Session

SE-TuP1 Oxidation and Nanopatterning of Thin Metal Films on Flexible Substrates via Oxygen Directed Irradiation Synthesis, ***Zachariah Koyn***, *B. Holybee, S.N. Srivastava, J.P. Allain*, University of Illinois at Urbana-Champaign

Ion bombardment of polycrystalline thin metal films is known to induce nanometer-scale surface patterning, including ripples and dots[1,2]. Additionally, the irradiation of metals with oxygen ions has been shown to induce surface oxidation, with a state dependence on fluence[3]. This work seeks to unravel the directed irradiation synthesis of oxide-based thin-films, in particular ZnO thin-films, with low-energy irradiation-driven mechanisms on dissimilar material substrates, such as polymer-based systems. This examines the dual effects of oxygen irradiation as a method of both oxidizing and patterning metal thin-films at ambient temperatures. This represents a scalable process in growing and functionalizing metal-oxide thin-films on polymers, which are sensitive to the high temperatures required in thermal oxidation processes. Ion-beam sputtering (IBS) is known to induce surface nanopatterning in multi-component systems[4] with simultaneous modification of surface chemistry. Irradiation with O^+ is performed at grazing incidence near 70° with particle energies between 25-1000 eV at ambient temperatures. X-ray photoelectron spectroscopy investigates the resulting oxidation states as a function of fluence from early-stage nanopattern formation near 10^{15} cm^{-2} up to fluences nearing a coarsening regime. Atomic force microscopy examines pattern formation under similar conditions. These results are then adapted to nanostructured thin-films on flexible substrates, namely polydimethylsiloxane (PDMS) about 1-mm thick and 1-cm^2. The ability to fabricate heterostructures on transparent, flexible substrates offers exciting applications in areas such as gas sensors, biosensors, and photonics[5]. Additional benefits of an oxygen ion beam are the chemical changes (formation of SiO groups, introduction of water and gaseous byproducts) induced in the PDMS substrate as the active thin-film is nanostructured. Oxidation of this polymer has been shown to induce significant temporary hydrophilicity[6] and thus provide for an effective bioactive nanostructured biointerface for in-situ endovascular protocols.

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