IT-001

Development of New Surfaces and Materials for Separation Science

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In the Linford group at Brigham Young University we have recently developed three new sets of materials for three different areas of separations science: thin layer chromatography (TLC), high performance liquid chromatography (HPLC), and solid phase microextraction (SPME).

First, via microfabrication we have grown patterned carbon nanotube (CNT) forests on planar substrates that we have infiltrated with inorganic materials such as silicon nitride. The coatings on the CNTs are conformal and typically deposited in a process like low pressure chemical vapor deposition. The resulting materials have high surface areas, are porous, and function as effective separation devices, where separations on our new TLC plates are typically significantly faster than on conventional devices. Second, we used the layer-by-layer (electrostatically driven) deposition of poly (allylamine) and nanodiamond onto carbonized poly (divinylbenzene) microspheres to create superficially porous particles for HPLC. Many interesting classes of molecules have been separated with these particles, including various cannabinoids, pesticides, tricyclic antidepressants, etc. Third, we have developed new materials for SPME by sputtering silicon onto cylindrical fiber substrates in a way that creates shadowing of the incoming flux so that materials with high porosity are obtained. These materials are currently outperforming their commercial counterparts. Throughout this work, the new materials we have made have been characterized by X-ray photoelectron spectroscopy, time-of-flight secondary ion mass spectrometry, scanning electron microscopy, transmission electron microscopy, etc.

Keywords: Materials, CNT, TLC, SPME, via microfabrication

IT-002

Mechanisms involved in modification of film structure and properties in ICP assisted dc and pulsed dc sputtering

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Modification of film structure and properties in inductively-coupled plasma (ICP) assisted dc and pulsed dc sputtering has been reported by Oya and Kusano [1] and by Sakamoto, Kusano, and Matsuda [2], showing drastic changes in films structure and properties by the ICP assistance in particular to the pulsed dc discharge. Although mechanisms involved in the modification has been reported to be the increase in energy transferred to the substrate, details of effects of low-energy ion bombardment on the modification and origin of an anomalous increase in the ion quantity by the ICP assistance to the pulsed dc discharge have not been discussed. In this presentation, mechanisms involved in film structure and property modification in ICP assisted dc and pulsed dc sputtering, in which a number of low-energy ions are formed, will be discussed based on ion energy distribution as well as effectiveness of energy transfer to the substrate by low energy particles [3]. The results discussed in this presentation will emphasize the fact that the energetic particles playing an important role in the film structure modification are those to be deposited, but not those of inert gas, when their energies range in less than 100 eV in the pressure range of magnetron sputtering.

References

1) T.Oya, E.Kusano, Effects of radio-frequency plasma on structure and properties in Ti film deposition by dc and pulsed dc magnetron sputtering, Thin Solid Films 517 (2009) 5837-5843.
2) M.Sakamoto, E.Kusano, H.Matsuda, Structure modification of titanium oxide thin films by rf-plasma assistance in Ti-O2 reactive dc and pulsed dc sputtering, Thin Solid Films 531 (2013) 49-55.
3) E.Kusano, N.Kikuchi, Modification of Ti and TiN film structure in pulsed dc and inductively-coupled-plasma assisted pulsed dc sputtering (tentative), submitted to Thin Solid Films.

Keywords: Inductively coupled Plasma assisted dc sputtering, dc sputtering