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MS-10-P-2449 Electron microscopy study of supercritical fluidselectrodeposition of mesoporous silica templates

Kashtiban R. J.[1], Beanland R.[1], Sloan J.[1], Cummings C.[2], Robertson, C.[2], Richardson, P.[2], Hector A. L.[2], Smith D. C.[2], Bartlett P. N.[2]

[1]University of Warwick, Coventry, UK, [2]University of Southampton, Southampton, UK

Email of the presenting author: r.jalilikashtiban@warwick.ac.uk

The importance and sophistication of materials deposition techniques can be seen in the cost of silicon fabrication facilities used to produce integrated circuits which are measured in billions of dollars. There now exists a wide range of deposition technologies. Vacuum techniques such as thermal evaporation, sputtering, chemical vapour deposition and molecular beam epitaxy are particularly suited to the deposition of high quality thin films. Whilst materials deposition is universal in technology, specific techniques can be found in particular applications in which their unique characteristics can surpass other techniques. For instance, as supercritical fluids have no surface tension and improved mass transport over liquids they have advantages over other deposition techniques for high aspect ratio trenches and pores [1].

Recent studies have shown that it is possible to electrodeposit a range of materials, such as Cu, Ag and Ge, from various supercritical fluids to grow nanowires. There are many reasons for the interest in nanowires for applications. These include at the simplest level the possibility of further miniaturisation of existing electronic and data storage components [2-3]. The proximity of the surface to the whole of the bulk of the nanowire makes nanowire chemical and biochemical sensors capable of single molecule sensitivity. In the field of thermoelectric materials, nanowires show increased figure of merit over bulk materials because of decreased photonic thermal

conductivity. Other routes by which nanowires could contribute to energy efficiency and generation include photovoltaic nanowire devices and piezoelectric nanowires [4-5]. The fact that nanowires are less susceptible to defects means that it may be possible to produce ultra-strength materials from them. Most of the near-to-market applications use nanowires with diameters in excess of 10nm, however initial investigations of ultrathin nanowires [6] suggest that these may be even more exciting in the medium term. In this contribution we will present results of materials recently prepared by supercritical fluid electrodeposition (SCFED) in mesoporous silica templates, with pore sizes as low as 3 nm. We use various electron microscopy techniques including high resolution transmission electron microscopy (HRTEM), high angle annular dark field scanning TEM (HAADF-STEM) and Energy Dispersive X-ray Spectrometry (EDS) in a doubly aberration-corrected electron microscope.

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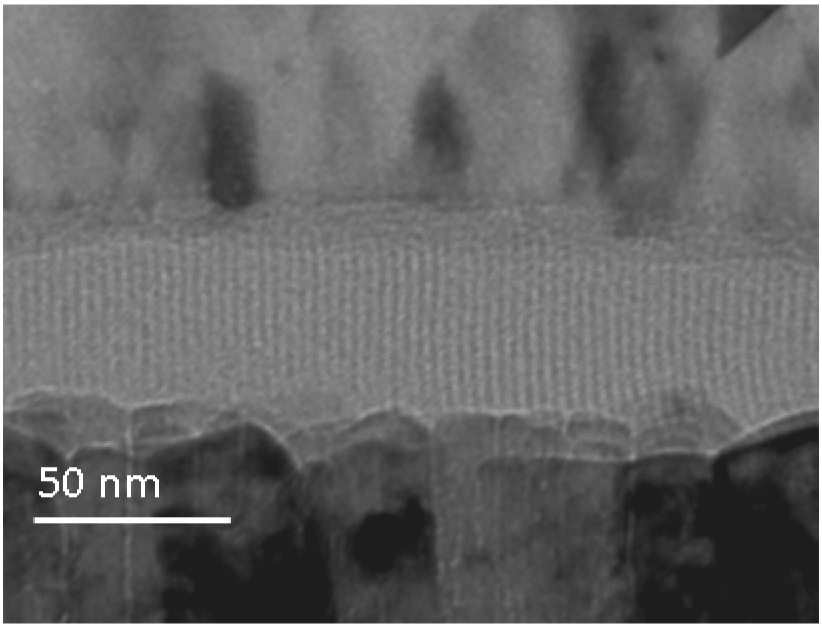

Fig. 1: TEM micrograph of 3 nm mesoporous silica pores

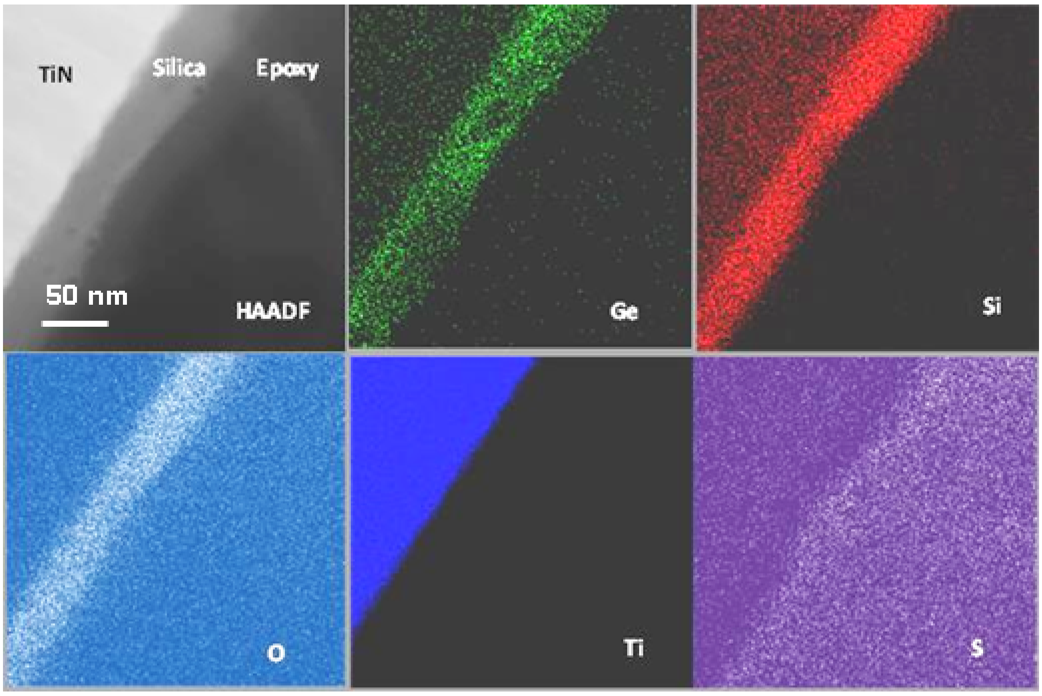

Fig. 2: EDS STEM elemental maps of Ge filled mesoporous silica film