Atom Probe Tomography Focus Topic
Room: Hall B - Session AP-TuP

Atom Probe Tomography Poster Session

AP-TuP1 Atom Probe Tomography of Energy and Environmental Materials, ***D.E. Perea**, A. Devaraj, R.J. Colby, J. Liu, D.K. Schreiber, J.E. Evans, S.A. Thevuthasan*, Pacific Northwest National Laboratory

Buried interfaces and surfaces play an essential role in the function of many materials for energy, environmental, and biological applications. An understanding of the physics and ultimate the ability to engineer materials with specific properties is aided by an atomic level understanding of the composition and morphology of interfaces. Atom probe tomography (APT) is a 3-dimensional compositional mapping technique based on the field evaporation of individual atoms from the tip of a needle-shaped specimen. At the Environmental Molecular Sciences Laboratory (EMSL), we are pushing the limits of APT analysis to study a wide variety of energy and environmental materials. We will present several examples that exemplify the breadth of materials which include semiconductor nanowires for high performance solar cell and transistors, geologic minerals used for atmospheric carbon sequestration, and glass materials for the vitrification of controlled waste.

AP-TuP2 Advantage of NbTiN over NbN in Superconducting Properties of Ultra-thin Films, ***M. Guziewicz**, A. Laszcz, J.Z. Domagala, K. Golaszewska, A. Czerwinski, W. Slysz*, Institute of Electron Technology, Poland

Progress in quality of ultra-thin superconducting niobium nitride films for fabrication technology of Superconducting Single Photon Detectors is still observed. Photon detection bases on a recording of current collapse pulse caused by a photon absorbed in the nanostructure film . Materials proved to be effective are Nb-nitride layers and the layers containing Ti . The latter applied in the detector structure have the advantage in the quantum efficiency and reduced noise by one decade compared to the NbN film . So far, there are no known causes of advantages of this material, but can be traced to them in a better quality of structure and uniformity of composition, which reduces the probability of scattering electron pairs on superconductors current defects . The confirmation of these assumptions may be the observation that better parameters are characterized by the detectors made with layers of amorphous than polycrystalline NbN and compete well with epitaxial NbN layers of single crystal characteristics . It can be find some papers where influence of substrate, sputtering deposition parameters and film thickness of NbN or NbTiN on critical temperature were studied. Our niobium nitrides films deposited on (0001)Al_2O_3 reveal excellent both superconducting and structure properties. Extensive characterization of the films using XRD, high resolution TEM and AFM were performed. High epitaxial quality of NbN and NbTiN films grown on the Al_2O_3 substrates is proved by HRXRD and HRTEM studies. The results of the studies on both NbN and NbTiN films reveal one cubic phase with NaCl-type structure. The critical temperatures of NbN and NbTiN films with thickness of few nm grown on the Al_2O_3 substrates are in range 4K ÷ 7K, but post-grown annealing of the films at 1000^{o}C in Ar increases temperature up to 12K or above. Moreover, the 5 nm thick NbTiN film deposited on sapphire at optimized conditions and annealed discloses the best superconducting properties - critical temperature of 14 K as well as extremely high critical current density of 12·MA/cm^2, while the critical current density of 3 MA/cm^2 was attained for the NbN film. This is the highest value measured on so thin Nb-nitrides films. The improvement in superconductor parameters can be explained due to reduced strain and defects by high temperature annealing of the film. Rocking Curve of the 111 Bragg reflection on the NbTiN is extremely narrow, ≈10 arcsec, characterising the best single crystals. Higher critical current density is almost certainly attained due to lower atomic concentration of oxygen contamination in the NbTiN films than in the NbN films.

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