Contribution ID: **28** Type: **Oral Presentation**

Surface structure modification of Cu(111) by Sb dopants for temperature sensing application

Thursday, 12 July 2012 16:20 (20 minutes)

Abstract content
   (Max 300 words)

Proper temperature sensing strategies improve reliability and can help avoid costly repairs and save energy. Optimized temperature sensing is important and a best practice which can help in innovative energy-efficient solutions. Copper (Cu) alloys are widely used materials with inherent attributes of high strength-to-weight ratio, superior corrosion resistance, excellent thermal conductivity and high electrical conductivity. The study presents a variable temperature scanning tunneling microscopy investigation of a Cu surface alloy when ˜0.43 monolayers of antimony (Sb) are grown at the sample surface in ultrahigh vacuum. It is well known that in alloys, the component with the lower surface free energy (surfactant), in this case Sb, segregates to the surface, making the surface

composition different from that of the bulk and thus the variation in the influence of temperature. The morphology of a surface at equilibrium, in particular its roughness, is related to the behaviour of the surface tension or surface free energy per unit area. Two distinct metastable structural phases $(2\sqrt{3}\times2\sqrt{3})R30^\circ$–Sb at 600˚C and $(2\sqrt{3}\times\sqrt{3})R30^\circ$–Sb at 700˚C were acquired for the first time in atomic detail on the Cu–Sb system. Both metastable superstructures reverted back to

the energetically stable $(\sqrt{3}\times\sqrt{3})R30^\circ$–Sb superstructure when cooled to room temperature and thus the implication of the surface alloy for temperature sensing

applications. Activation energies for the formation of the Cu–Sb surface alloy at different temperatures were determined from the acquired STM data and the linear and

surface coefficients of expansion were found to be 4 orders of magnitude higher than the bulk values at room temperature.

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Session Classification: DCMPM2

Track Classification: Track A - Division for Condensed Matter Physics and Materials