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Proton irradiation induced welding and fabrication of copper nano-wires network

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As a substitute for conventional transparent electrode, thin films of metal nanowires networks have long been act as promising contenders due to their high flexibility. However, nanowire-nanowire contact resistance is the main technical hindrance in terms of improvement in their performance. Here, random network of copper nanowires (Cu-NWs) is successfully prepared by spray coating on glass substrate followed by proton beam irradiation. A spray gun was used to coat a glass substrate with solution of Cu-NWs. While solution processed random network is coated on glass substrate, proton ion beam induced sputtering of atoms from nanowires lattices followed by point defects production and accumulation at crossing sharp angle interface regions, through molten zones introduced by proton ion induced thermal spikes, eventually solidify and lead to connect the nanowires. Using spray coating method, Cu-NWs thin film could be uniformly coated on a large area substrate, and spontaneously ion beam induced welding is carried out between nanowires in the network. Spray coated followed by proton beam induced welded Cu-NWs networks could improve performance by reducing contact resistance for application as a transparent electrodes.

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Rapid and non-destructive detection of nanoparticle distribution on solid surface via intensity fluctuation of dynamic laser scattering

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In present day, nanotechnology is developed and applied into many scientific and industrial fields, such as, medicine, nanocomposite coating, and optoelectronics. Essentially, the performances of various types of device rely heavily on the detail of nanoparticle distribution on substrate surface, for instance, superhydrophobic coating, quantum dot solarcell, plasmonic device and silicon wafer. In this work, the fluctuation of laser intentisy scatterred from nanoparticles is used for the interpretion of areal distribution of the nanoparticles. A coherent light source was focused on a layer containing ensemble of nanoparticles, generating Mie scattering signal which is collected by an objective lens and subsequently detected by a femtowatt photodiode. Monolayers of silica nanospheres on glass substrates with various particle density, fabricated by electrostatic self-assembly technique, were used in this investigation. The substrate was set in motion with constant velocity using a motorized stage, such that the laser beam was scanned across the entire area. This results in dynamic Mie scattering which fluctuates the scattered light intensity from the nanoparticles on the moving surface. The pattern of the fluctuating signal depends strongly on spatial distribution of the silica particles and the velocity of the motion. To analyze the signal, autocorrelation function was implemented to determine time correlation of the scattered light intensity. Together with the single scattering approximation and the particle velocity information, the mean spacing distance between individual nanoparticles can be retrieved in short period of time.

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