Abstract

The present study deals with designing and fabrication of an experimental setup for Argon (Ar) thermal plasma generation and for implementation of surface structuring of Bi. The effect of Ar thermal plasma treatment on morphological, compositional, electrical, contact angle and mechanical properties of Bismuth (Bi) has been investigated. Ar plasma parameters have been investigated by using SSNTD and Faraday cup techniques. In the present work polycrystalline Bi has been treated at various Ar gas flow rates ranging from 10 L/mint to 25 L/mint for a fixed time interval of 10 minutes. Bi targets were also treated at different treatment times ranging from 10 minutes to 25 minutes at constant gas flow rate of 15 L/mint. Optical microscopy and Scanning Electron Microscope (SEM) analyses reveal the melting, evaporation, splashing, collisional sputtering, coalescence fusion and ejection of materials at different gas flow rates which are responsible for the formation of protrusions, cavities, cones, particulates, melt pools and agglomerates. At different treatment timings, ejection of materials, thermal desorption, reattachments, re-solidification and recrystallization are responsible for particulates, cavities and conical spike formation. XRD patterns reveal the slight higher angular peak shifting and intensity enhancement at the lowest treatment time and gas flow rate. At the highest flow rate and treatment time, some new phases of Bi_2O_3 are identified. However, an increasing trend in peak intensity, crystallite size, induced stresses and the decreasing trend in dislocation line density is observed with increasing the thermal plasma treatment time and flow rate which are attributed to improved crystalline nature. FTIR analysis shows the considerable increase in existing peaks intensities of BiO without identification of new band in plasma treated Bi. After thermal plasma treatment the decreasing trend in electrical conductivity along with contact angel and increasing trends in hardness are attributed to enhancements in defects generation and surface roughness.