ABSTRACT

There is a high risk involved in the failure of bioimplants through the release of toxic metal ions into the biological environment. In this study, the concept of stable isotopic tracing was used as a diagnostic tool for the detection of implant materials that fail through the release of metal ions. The study was carried on commercially used SS316L and Ti6Al4V bioimplant materials by using Ag and Cu as a tracer material. The tracers were inserted into the matrix of the respective bioimplants using a physical vapor deposition technique followed by heat treatment. The nature of tracer distribution and oxide formation of tracer diffused implants were characterized using X-ray Diffraction, Scanning Electron Microscopy, and Energy Dispersive X-ray Spectroscopy techniques. The effects of tracer coating were studied by contact angle and surface energy measurements. Static immersion tests were performed for the release of metal ions, and tracers from the tracer coated, and tracer diffused implants in various media, namely Phosphate Buffer Saline, Simulated Body Fluids, and HCl. The trace concentrations of metal ions and tracers released in respective media were quantified using Inductively Couple Plasma Mass Spectroscopy. The results showed the controlled release of tracers along with the metal ion release in tracer diffused implants, unlike tracer coated implants, which showed the burst release of tracers. The results suggest that the Cu tracer system was effective in tracing the metal ions released from the SS316L, and the Ag tracer system was effective for Ti6Al4V, respectively. Additionally, the tracer modified implant surface were also found to be more effective against microbial activity when compared to untreated alloy.