Role of $\beta$-silver sulfide solid electrolyte on Ag nanofilament fabrication for surface-enhanced Raman spectroscopy activity

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Abstract: In this work, we have developed a facile method to fabricate a high-density of silver nanofilaments (Ag NFs) based on $\beta$-silver sulfide ($\beta$-Ag$_2$S) solid electrolyte used as a surface-enhanced Raman spectroscopy (SERS) substrate. A chemical bath deposition was chosen to prepare $\beta$-Ag$_2$S solid electrolyte due to its low-cost and high-throughput deposition method. Electron beam irradiation was used to construct Ag NFs due to its short reaction time, high efficiency and the absence of chemical residues after the reaction. The amount of $\beta$-Ag$_2$S has a strong effect on the Ag NFs formation. The highest density of Ag NFs as SERS substrate was found to be 1.03x10$^9$ filaments/cm$^2$. The SERS performance of methylene blue (MB) adsorbed on AgNFs substrate has been investigated with green laser (532 nm). The maximum SERS enhancement factor of 1.57x10$^6$ was achieved. The limit of detection of MB obtained from AgNFs substrate was found to be 1 µM.

Keywords: Silver nanofilaments; $\beta$-silver sulfide; Solid electrolyte; Electron beam irradiation; SERS