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Comparison of seed layers for smooth, low loss silver films used in ultraviolet-visible plasmonic imaging devices

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Abstract:

Germanium, copper and silver(I) oxide seed layers are investigated for their ability to reduce the roughness of silver thin films deposited on amorphous substrates. Such films are useful in disease detection and sub-wavelength imaging applications, provided their surface roughness is sufficiently low so as to give a strong plasmonic response. Surface roughness and optical transmission measurements are reported for thermally evaporated and radio frequency sputtered silver films between 10–40 nm thick, grown either directly on amorphous borosilicate glass substrates or on top of 1 nm thick seed layers. It is found that germanium, copper and silver(I) oxide seed layers all have a smoothing effect on silver films up to 20 nm thickness. In the best case, the root means square surface roughness of a 10 nm silver film thermally evaporated onto borosilicate glass was reduced from 2.16 ± 0.16 nm to 0.71 ± 0.04 nm by the inclusion of a 1 nm thick germanium seed layer. For films thicker than 20 nm only germanium had a