Photonic applications of nanocolumnar Au films obtained by glancing angle deposition with magnetron sputtering

María Ujué González[1]
Alan Vitrey[1], Rafael Álvarez[2], Alberto Palmero[2], Pablo Díaz-Núñez[3], Antonio Rivera[3], Ovidio Peña-Rodríguez[3], José Miguel García-Martín[1]

[1]*Instituto de Micro y Nanotecnología, IMN-CNM, CSIC, Isaac Newton 8, 28760 Tres Cantos, Madrid, Spain*
[2]*Instituto de Ciencia de Materiales de Sevilla (CSIC-US), Americo Vespucio 49, 41092 Seville, Spain*
[3]*Instituto de Fusión Nuclear, ETSI Industriales, Universidad Politécnica de Madrid, C/ José Gutiérrez Abascal 1, 28002 Madrid, Spain*

maria-ujue.gonzalez@csic.es

In the last few years, we have fabricated metallic coatings with nanocolumnar morphology by means of glancing angle deposition with sputtering [1-3]. This technique allows for obtaining nanostructured coatings onto any kind of flat substrates and it can be scaled up to large areas. Depending on the deposition parameters (such as gas pressure, tilt angle, substrate rotation, etc.), the nanocolumnar structure can be controlled, giving rise to different properties [4]. In particular, for gold coatings we have obtained specific optical properties related to the existence of localized surface plasmons associated with the nanopillars.

When vertical nanocolumns are produced by using substrate rotation and high tilt angle, the coatings show black metal behaviour in the visible range [5], with reflectivity below 10% in the 400-700 nm range (see Figure).

On the other hand, when short tilted nanocolumns are fabricated, hot spots of electromagnetic field develop and provide a strong enhancement of the fluorescence or Raman signals. As a result, this is a low cost approach to prepare SERS substrates by a physical vapour deposition technique.

References

[1] J.M. García-Martín *et al.*, Appl. Phys. Lett. 97 (2010) 173103.
[2] R. Alvarez *et al.*, Nanotechnology 24 (2013) 045604.
[3] R. Alvarez *et al.*, J. Phys. D: Appl. Phys. 49 (2016) 045303.
[4] I. Izquierdo-Barba *et al.*, Acta Biomaterialia 15 (2015) 20.
[5] A. Vitrey *et al.*, Beilstein J. Nanotechnol. 8 (2017) 434.

Figures

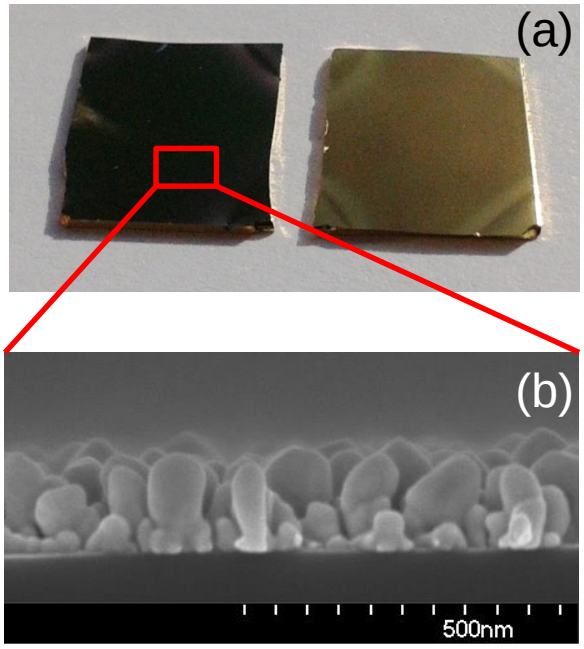

Figure: (a) Photograph of two Au samples prepared by glancing angle deposition with sputtering onto rotating Si substrates with deposition angles 87° (left) and 75° (right). Notice the black colour of the left sample. (b) Cross section SEM image of the left sample.