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Gas sensor based on Au nanoparticles embedded in a CuO matrix by HR-LSPR spectroscopy at room temperature

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Gas sensing, based on bulk refractive index (RI) changes, has been a challenging task for localized surface plasmon resonance (LSPR) spectroscopy [1]. In this work, it is demonstrated that a plasmonic thin film composed of Au nanoparticles embedded in a CuO matrix can be used to detect small changes (as low as 6×10-5 RIU) in bulk RI of gases at room temperature, using a High-Resolution LSPR spectroscopy system [2,3]. Such thin film system was optimized by reactive magnetron sputtering, followed by an in-air annealing protocol treatment at 700 ^{0}C to promote the Au nanoparticles growth. To enhance the film's surface activity, a simple Ar plasma treatment revealed to be enough to remove the top monolayers of the film and to partially expose the embedded nanoparticles, and thus promoting the film's gas sensing. The treated sample exhibit high sensitivity to inert gases (Ar, N2), presenting a refractive index sensitivity to bulk RI changes of 425 nm/RIU. Furthermore, a 2-fold signal increase was observed for O2 and CO gases, showing that the thin film system is clearly more sensitive to these non-inert gases, due to, most probably, gas adsorption on the film surface. The results show that the Au:CuO thin film system has a high sensitivity to detect small RI changes caused by different gases, supporting the potential of this thin film system to be employed as a gas sensor, particularly in CO detection.

Scientific Area

New principles and technologies for sensing

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