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高拉曼增强银纳米帽阵列活性基底的模板法制备及其性能

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Controlled Assembly of Ordered Nanoarrays for High SERS-active Substrates Using Templates

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- 摘要
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摘要 介绍了一种大面积高度有序、结构可控、信号增强显著、信号均一稳定、制备简单的拉曼增强活性基底的制备方法. 以超薄氧化铝(ultra-thin alumina mask, UTAM) 作为模板,通过热蒸发在UTAM 表面沉积一定厚度的银薄膜, 将银薄膜翻转制得大面积结构有序、参数可调的银纳米帽阵列. 采用罗丹明6G (Rhodamine 6G, R6G)为探针分子测试不同模板参数下制备的基底的拉曼活性. 结果表明: 该结构作为表面增强拉曼散射(surface-enhanced Raman scattering, SERS) 衬底, 拉曼增强效果非常显著, 拉曼增强因子最高可达10^9, 约是相同厚度的银薄膜SERS 强度的16.4 倍, 而且信号均一稳定, 基底参数对表面拉曼增强效果可调控. 该制备方法操作简单, 成本低, 易于批量生产, 不同批次间可重复性高, 可用于化学物质和生物分子的痕量分析.

关键词: 超薄氧化铝模板 银纳米帽阵列 表面拉曼散射增强 均一性 可重复性

Abstract: A simple method to fabricate a large-area highly ordered and structure controlled surface enhanced Raman active substrate with giant enhancement, uniformity and reproducibility is reported. Silver ordered nanocap arrays were fabricated using thermal evaporation in vacuum with UTAM as a shadow mask. The structure can be tuned further to optimize the enhancement factor according to UTAM fabrication parameters. The surface-enhanced Raman scattering (SERS) measurement results of active substrate with Rhodamine 6G as probe molecules showed a strong SERS effect with an enhancement factor (EF) up to 10^9, and high uniformity and reproducibility. Compared with the same thickness ordinary Ag film, the SERS enhancement effect of the Ag nanocap arrays is about 16.4 times stronger. This preparation method has the advantages of simple operation, low cost, ease of mass production, and high repeatability between different batches. The active substrate can be used for trace analysis on chemicals and biological molecules.

Keywords: ultra-thin alumina mask (UTAM), Ag nanoarrays arrays, surface-enhanced Raman scattering (SERS), uniformity, reproducibility

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