Silver (I) Oxide and Silver (I, III) Oxide Formation via Femtosecond Laser Micromachining

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Silver oxides have many applications, such as in energy storage in silver/zinc reserve batteries and supercapacitors [1,2] and Surface-Enhanced Raman Scattering [3]. They also have promising antibacterial properties [4] and could be used for artificial photosynthesis [5]. Silver oxides are often manufactured via reactive sputtering [2], ozone gas flow [6], oxygen plasma treatment [7] and Pulsed Laser Deposition [4].

In this research, silver (I) oxide (Ag_2O) and silver (I, III) oxide (AgO) have been formed from machining bulk silver with an ultrafast laser in ambient air. A frequency-doubled Ytterbium Doped Potassium Gadolinium Tungstate (Yb: KGW) laser is used to irradiate a silver sample to make a series of craters. The sample is then brought to a Raman microscope for chemical analysis, where a map of each oxide is created, as shown in Figure 1. The effects of some laser machining parameters on the formation of silver oxides are investigated. The decomposition of silver oxides created this way is also investigated. It was found that increasing the number of pulses and the pulse energy both favor the formation of Ag_2O and AgO. AgO created from ultrafast laser machining tends to decompose quickly in ambient air.

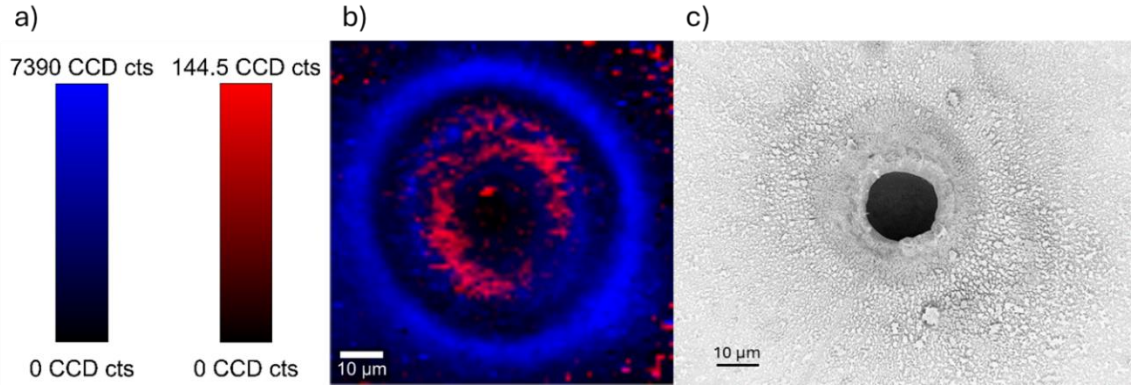

Figure 1: Example of a Raman scan for a laser machined dot. (a) Scalebars, (b) Raman image, (c) SEM image of a different crater with corresponding laser machining parameters.

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