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Pressure Induced Evaporation Dynamics of Gold Nanoparticles on Oxide Substrate

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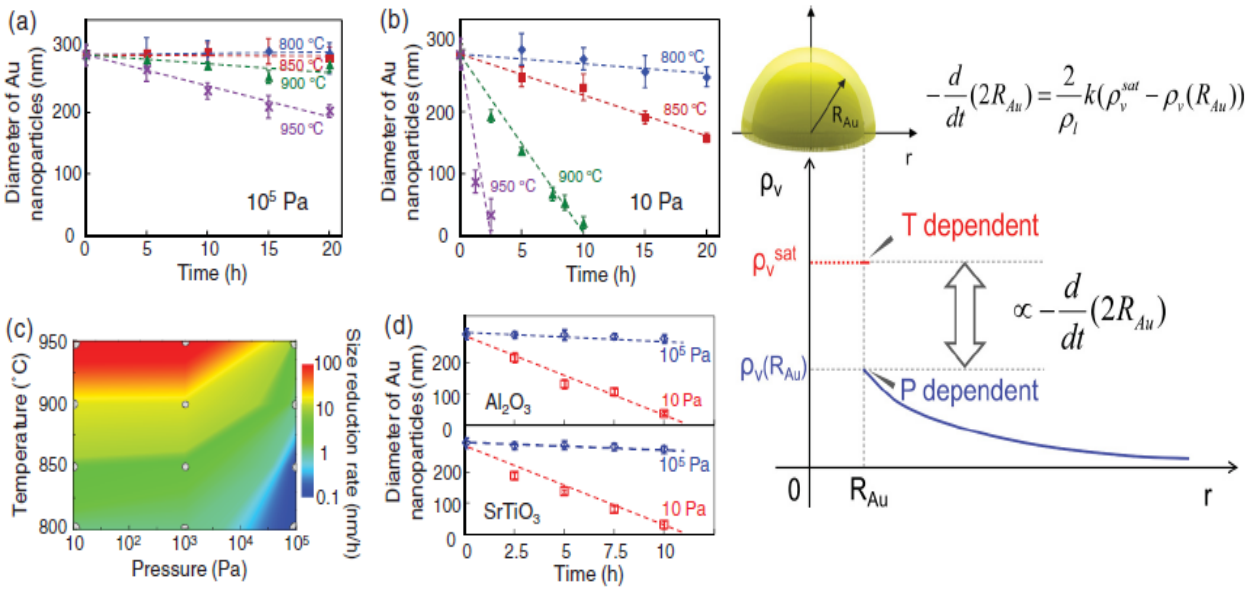
Here we report thermal evaporation dynamics of Au nanoparticles on single crystal oxide substrates, including MgO, $SrTiO_3$ and Al_2O_3. The size reduction rate of Au nanoparticles via thermal treatments is strongly dependent on not only a temperature but also a pressure. Lowering a pressure of inert Ar gas from 10^5 Pa to 10 Pa increases the size reduction rate over 30 times under the temperature range 800-950 °C. The temperature dependence is solely due to the variation of saturated vapor pressure of Au, whereas the pressure dependence of surrounding inert gas can be interpreted in terms of a pressure dependence on a gas-phase diffusion of evaporated Au atoms into surroundings. We present a simplified model to explain an evaporation dynamics, which well describes the pressure dependence on a size reduction rate of Au nanoparticles. By utilizing this useful pressure induced evaporation dynamics, we succeeded in manipulating a size reduction of Au nanoparticle arrays down to -10 nm diameter range from -300 nm initial size by programming sequentially a surrounding pressure.



Reference: *Meng et al.* ***Phys. Rev. E, 87****,* 012405 (2013).