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Acoustic Cavitation near Metal Surfaces Contaminated with Radionuclides



Ran Ji, Matthieu Viot, Rachel Pflieger, Sergey I. Nikitenko

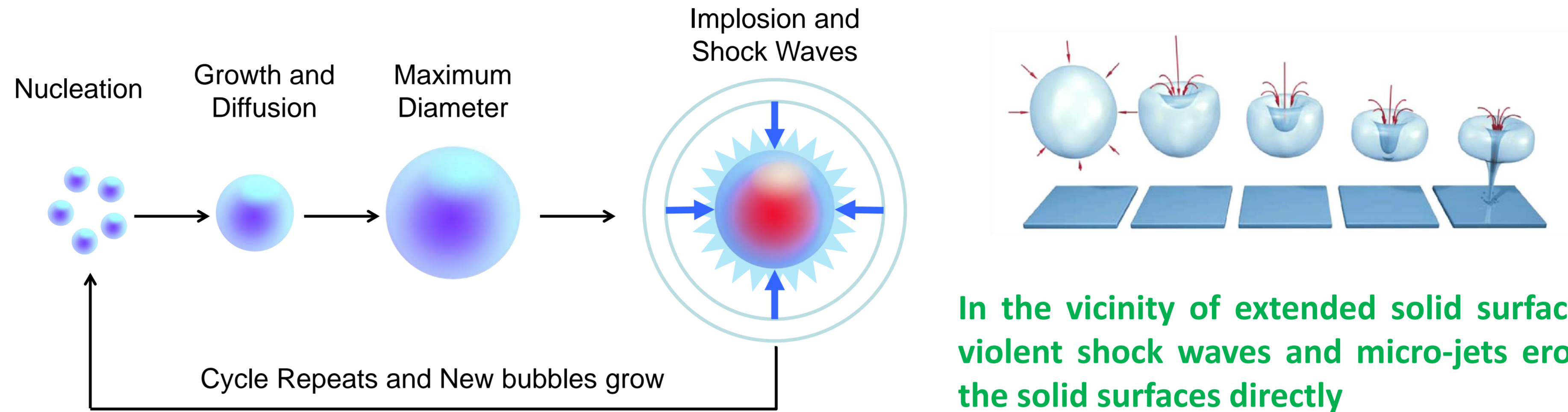
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Site de Marcoule, BP17171, 30207 Bagnols sur Cèze, France



Ultrasonic cleaning is a widely used technology in the areas of industry, scientific research and medical application. It is able to decontaminate items with complex surfaces with less damages and erosion to the material. It is interesting and important to apply this method to nuclear waste decontamination process to remove radioactive nuclides and finally reduce the volume of radioactive solid wastes.

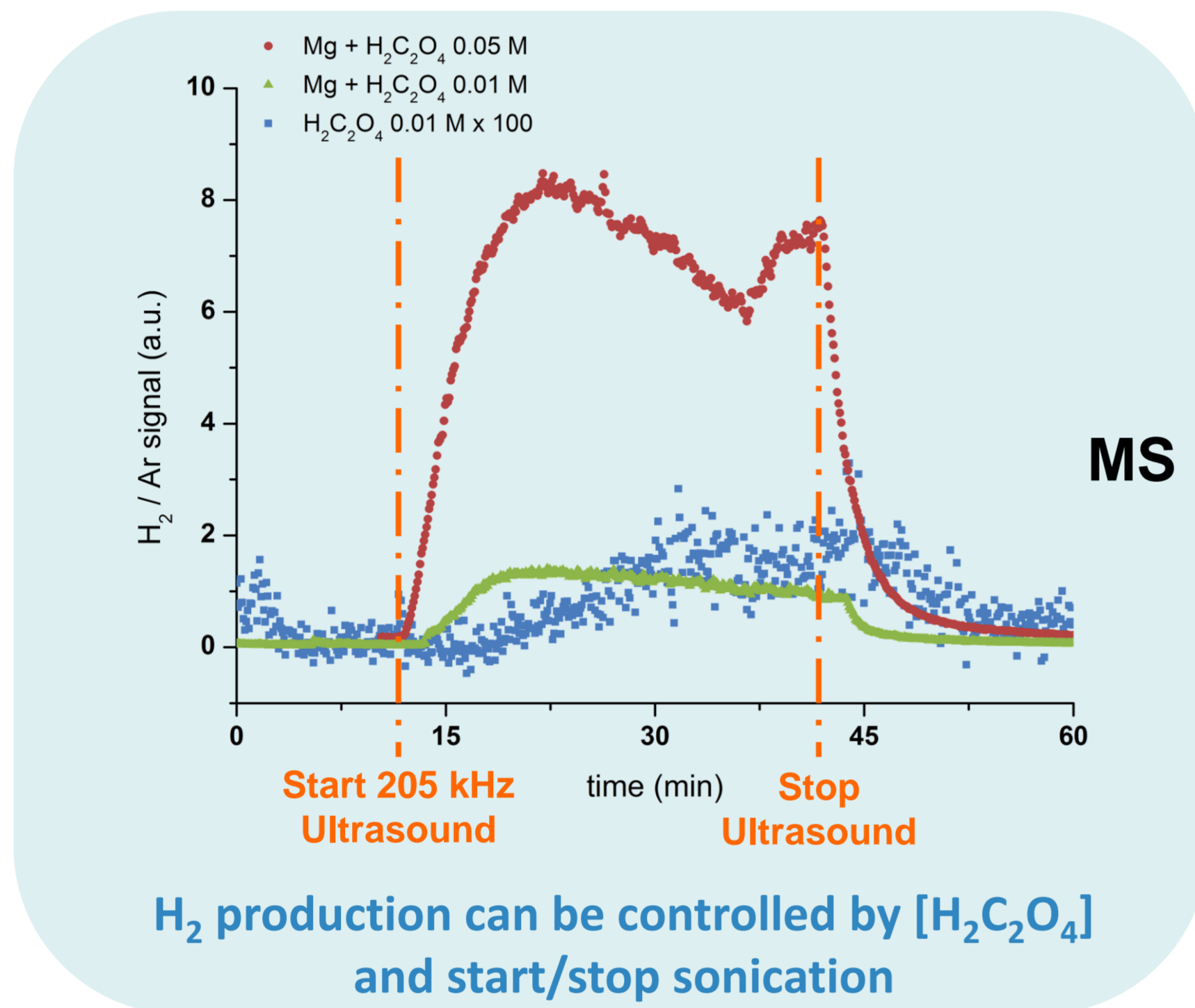
Ultrasonic cleaning is based on acoustic cavitation, which creates extreme temperature and pressure (plasma) inside bubbles, forms radicals and excited species, and induces mechanical effects (shock wave, microjets) in solutions.



Mg Surface Sonication Experiments

Mg surfaces immersed in oxalic acid saturated with argon at 18 °C, agitation and sonication

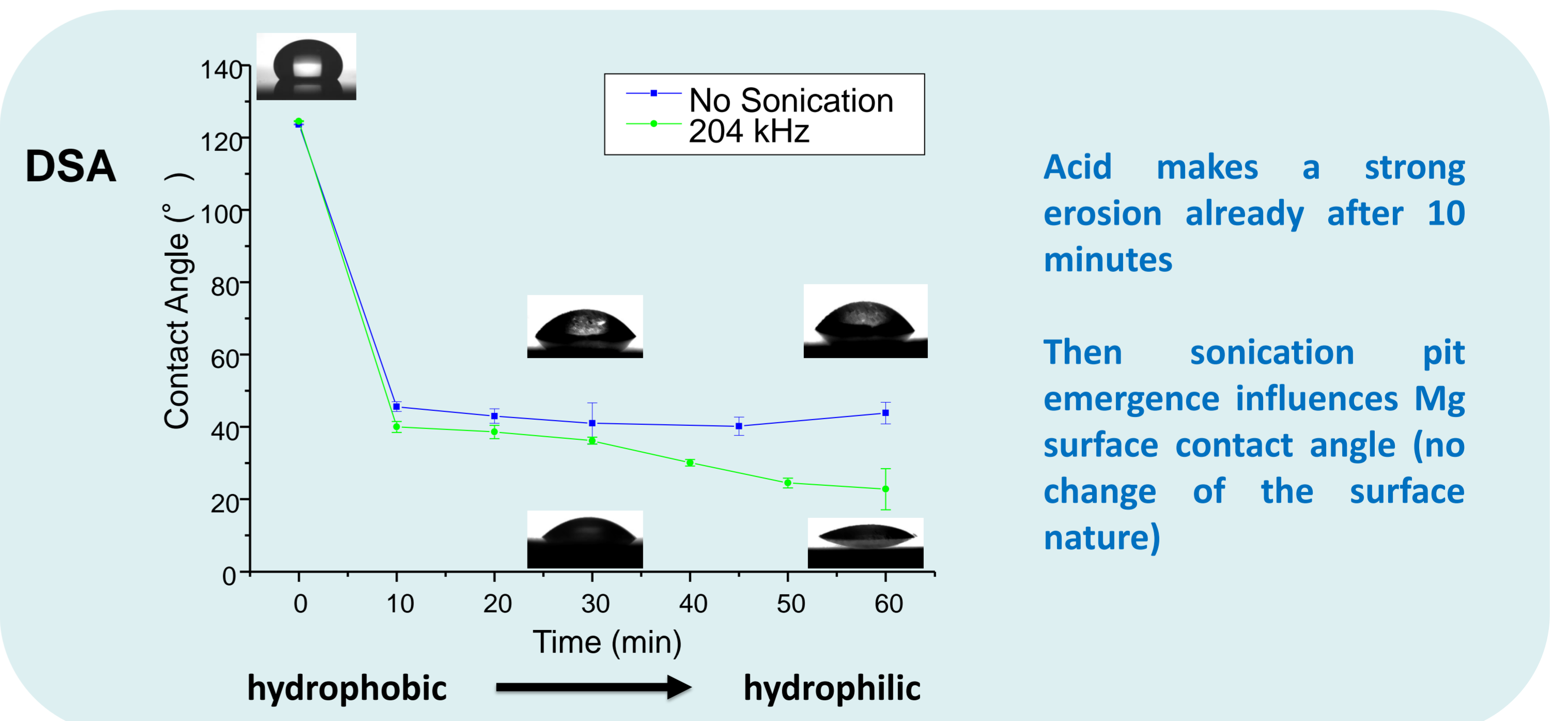
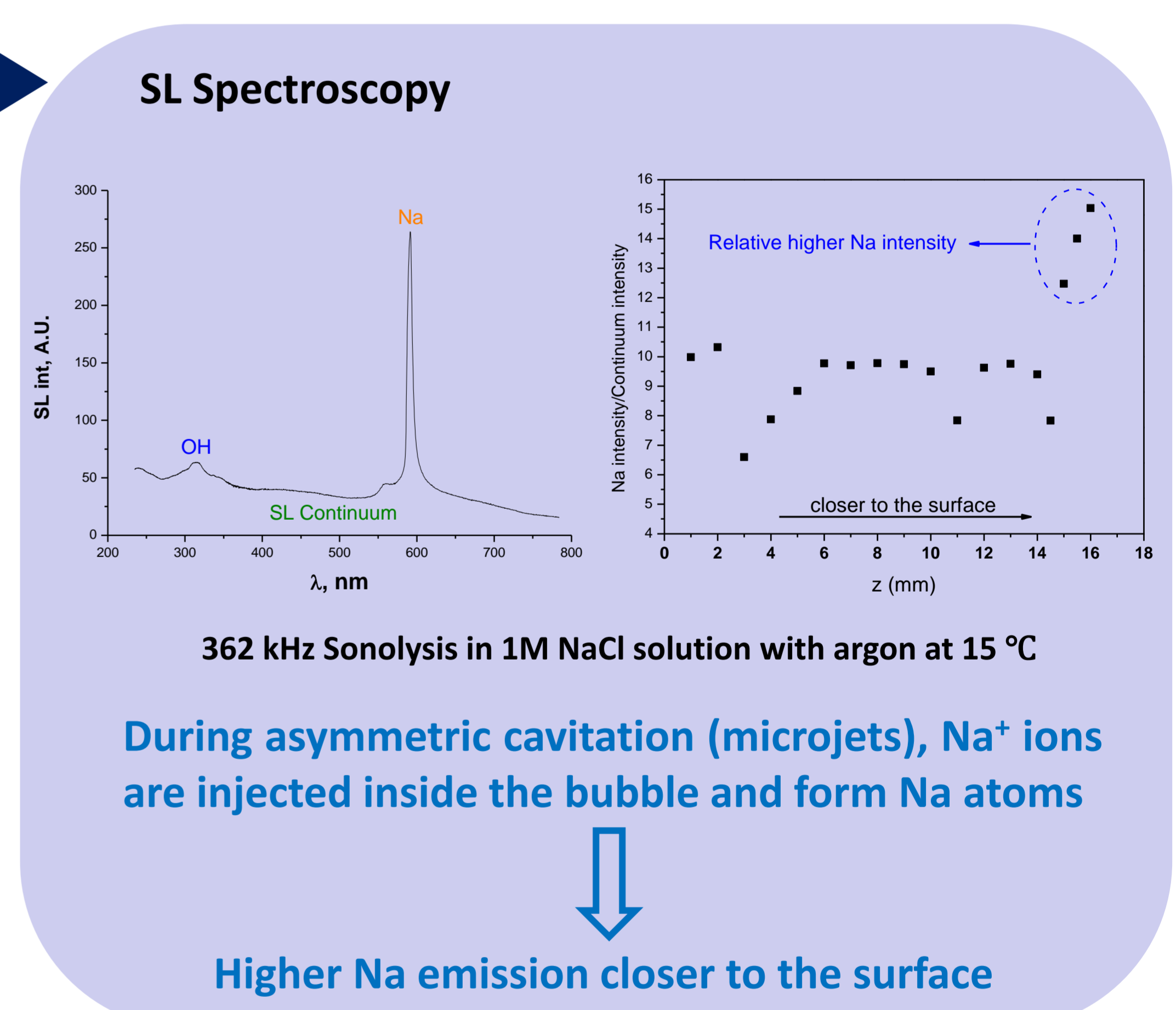
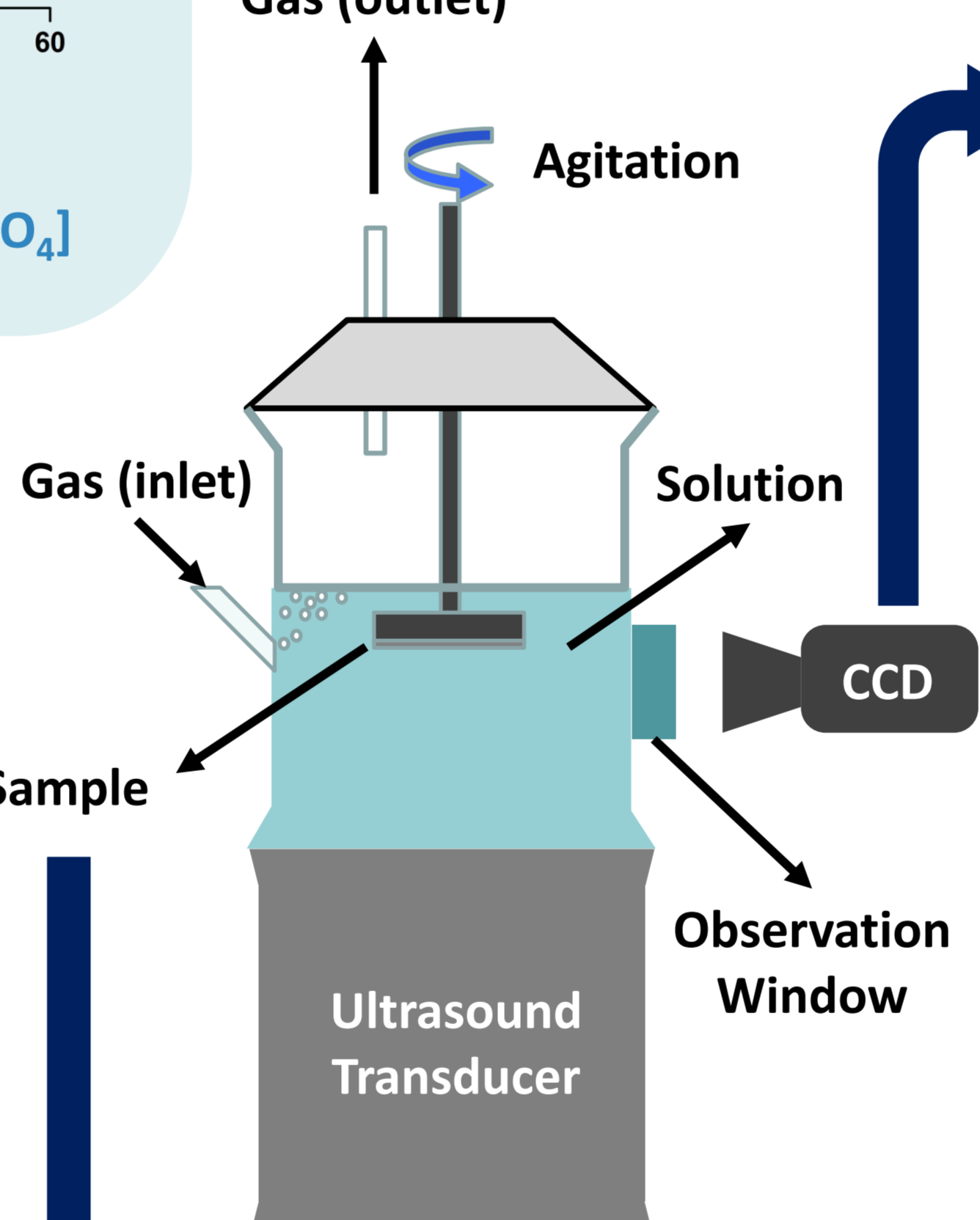
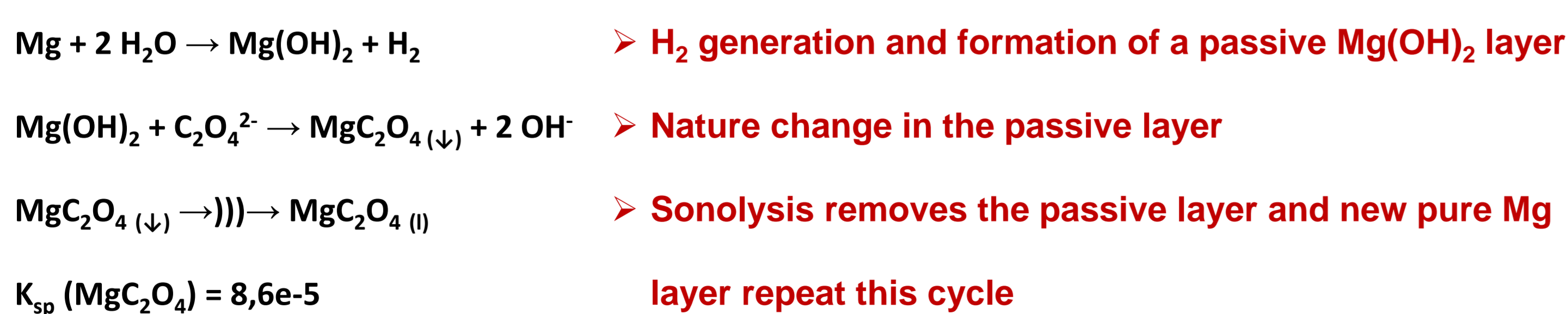
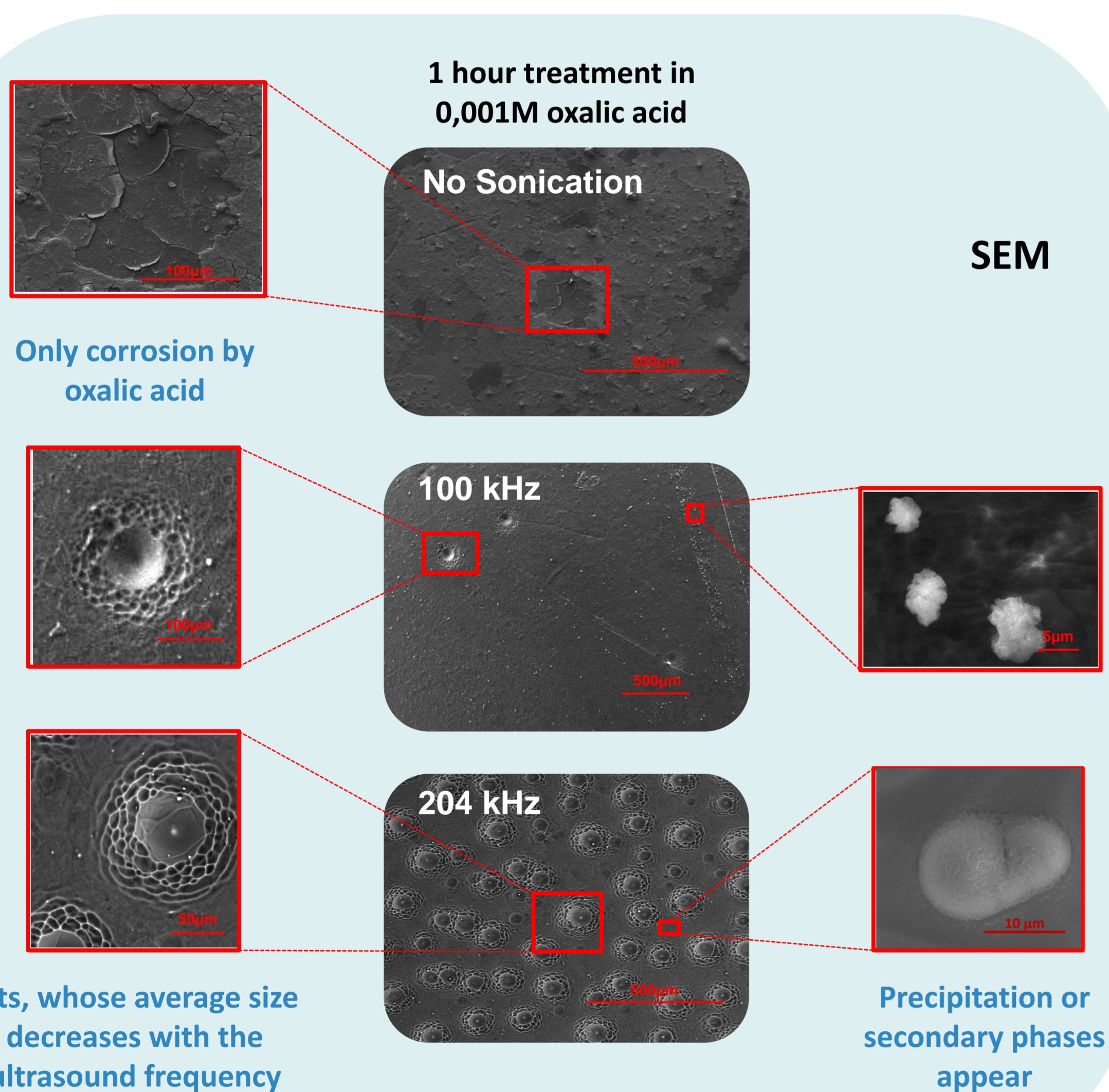
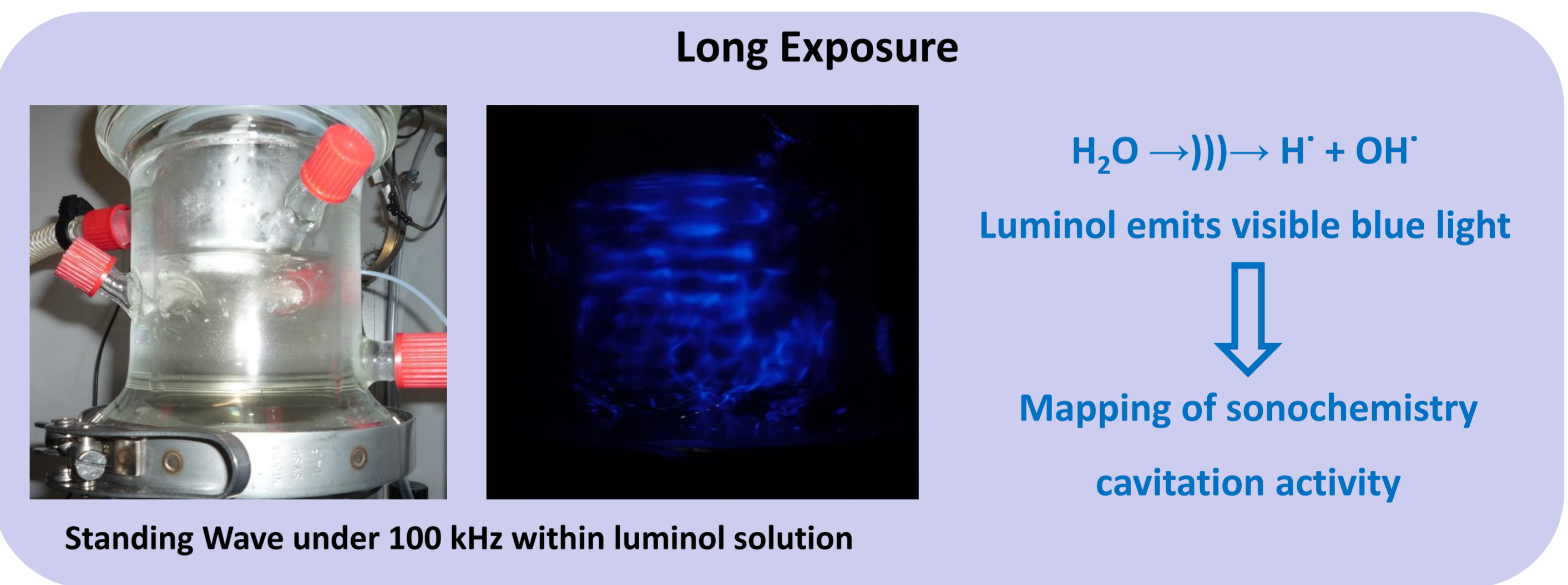
- Mass Spectrometer (MS) monitors H₂ production in gas
- Scanning Electron Microscope (SEM) follows surface morphology
- Drop Shape Analyzer (DSA) measures contact angle of surface



Sonoluminescence Experiments

Excited radicals and species can be detected by their sonoluminescence (SL) light

- Long exposure gives standing waves distribution
- SL spectroscopy quantify light intensity



Sonication results indicate that Mg decontamination is possible by controlled dissolution of surface. Mg surface morphology is transformed from hydrophobic to hydrophilic, with pits and the appearance of precipitations or secondary phases. By modifying [H₂C₂O₄] or start/stop ultrasound, it is possible to control the generation of H₂ and the dissolution of Mg.

In the presence of a metal surface, sonoluminescence spectra show that Na atom relative intensity increases. It proves the impact of solid surface to the cavitation bubble deformation in solution, and this impact is only effective close to the surface (≈ 3 mm).