MASTER'S THESIS

Laser ablation of aqueous samples at 193-nm: mechanism and applications

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Laser Ablation of Aqueous Samples at 193-nm: Mechanism and Applications

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ABSTRACT

In the laser ablation of aqueous samples, earlier studies showed that the plasmas induced by ArF laser were cooler than that generated in conventional laser-induced breakdown, while the electron density was comparable. As a result, the signal-to-background ratio of the analyte line emissions was thousands of times better, making 193-nm ablation an extremely sensitive analytical technique. To further that work, the present thesis addressed two outstanding issues. First, at the low plasma temperature when thermal ionization might not be extensive, the mechanism of free electron production in ArF laser ablation remained puzzling. We found that 193-nm photoionization of vibrationally excited water molecules was a probable channel. Second, for several elements including sodium and potassium, the ArF laser probe gave excellent *mass* detection limits when sub-breakdown laser fluence was used for microanalysis. For trace analysis, higher laser fluences would be required to ablate enough sample material to yield a detectable number of analyte atoms in the probed volume. We showed that ArF laser ablation still gave record-low *relative* detection limits in this high fluence regime.

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