Application of Grating Ti:Sapphire Laser to Resonance Ionization Mass Spectrometry

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We have developed a grating Ti:Sapphire laser for resonance ionization. For ease of operation, allowing use by untrained personnel, we implemented computer controlled wavelength selection and stabilization including an intra-cavity second harmonic generation stage.

Keywords: Resonance Ionization, Mass Spectrometry, Ti:Sapphire laser

Resonance ionization mass spectrometry (RIMS), which is based on efficient excitation and ionization via atomic energy levels by tunable laser and subsequent mass spectrometry, is useful for trace determination of long-lived radioactive isotopes. A wide tuning range and quick wavelength changes are important properties of a tunable laser system applied for RIMS. We have developed a grating Ti:Sapphire (Ti:Sa) laser for RIMS. The grating Ti:Sa laser (shown in Fig. 1) is pumped by a Nd:YAG pulsed laser and second harmonic generation (SHG) takes place in a BBO crystal positioned between two dichroic cavity mirrors enabling output coupling of the second harmonic and the restriction of the fundamental mode to the Ti:Sa cavity. This provides for a more compact and efficient tunable laser source in the blue wavelength region compared to external single pass SHG configurations. Wavelength selection and scanning is performed via a computer interface using feedback control of the wavelength sensitive elements in the cavity. Our laser system covers an operating wavelength range from 730-920 nm in the fundamental and from 360 to 420 nm when applying the intra-cavity SHG stage as shown in Fig. 2. Typical pulse energies up to 250 uJ in the fundamental and up to 50 uJ in the second harmonic at repetition rates up to 10 kHz have been achieved.

This laser system will simplify the development of new ionization schemes and enable fast exchange between different ionization schemes for multi-elemental analysis. The presentation will cover an overview of the system and results of a demonstration RIMS experiment on a Zirconium sample.

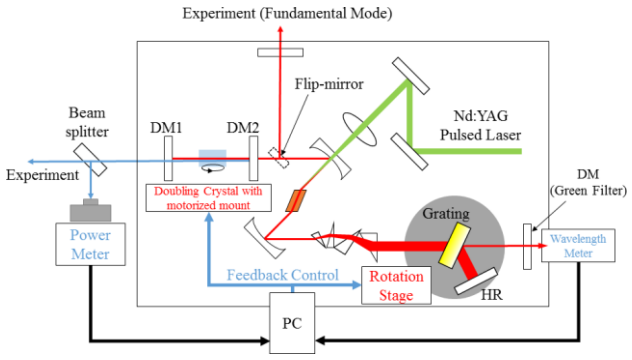

Fig. 1 Experimental setup of the grating Ti:Sa laser system with intra-cavity SHG. DM – Dichroic mirror, HR – High reflection mirror.

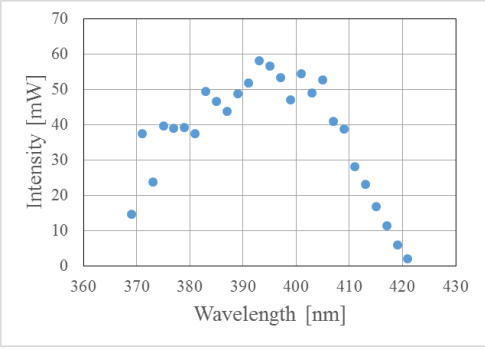

Fig. 2 Tuning curve of the grating Ti:Sa laser in the SHG range at repetition rates of 1 kHz .

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