

# Diode Laser Excited Optogalvanic Spectroscopy of Glow Discharges

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**Abstract.** The development of diode-laser-excited isotopically-selective optogalvanic spectroscopy (OGS) of uranium metal, oxide and fluoride in a glow discharge (GD) is presented. The technique is useful for determining isotopic ratios of  $^{235}\text{U}/(^{235}\text{U} + ^{238}\text{U})$  in the above samples. The precision and accuracy of this determination is evaluated, and a study of experimental parameters pertaining to optimization of the measurement is discussed. Application of the GD-OGS to other f-transition elements is also described.

## INTRODUCTION

The application of diode lasers to isotopically-selective atomic spectroscopy has been of interest to us for several years. Previously we carried out isotopically-selective resonance ionization mass spectrometry of lanthanum using diode lasers in the first step of a multistep of the resonant excitation.<sup>(1)</sup> At the last RIS meeting, our initial studies of the use of diode laser excitation for isotopically-selective optogalvanic spectroscopy (OGS) of uranium in a glow discharge (GD)<sup>(2)</sup> was presented. The study of uranium GD-OGS continues to be a main area of investigation. The technique of using diode lasers for GD-OGS studies has applications to other elements and for other purposes besides analytical determinations. Our work in these areas, particularly with lanthanides and uranium is the subject of this report.

## EXPERIMENTAL

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The details of the experimental set-up for these studies have been described elsewhere<sup>(2,3,4)</sup> but are summarized here. A demountable GD cell containing a see-through cathode was used. The cathode was a metal or composite hollow cylinder approximately 5 mm O.D., 2.4 mm I.D., and 2.5 mm in length. The composite cathodes were pressed from a 50-50 weight % mixture of a sample powder and a metal powder (Ag or a mixture of Ag-Ta). The cell body served as the counter electrode of the discharge. The OGS signal was generated by excitation with either an argon-ion laser-pumped titanium:sapphire (Ti:S) ring laser or with semiconductor diode lasers. The power of these lasers was controlled in the range of 30 to several hundred mW. The laser radiation was chopped at 1000 Hz and directed as a focused beam (50 $\mu$  dia.) through the cathode. For OGS measurement, the ac component of the cathode voltage is observed on an oscilloscope and a lock-

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