# LASER-HOLLOW CATHODE DISCHARGE EMISSION SPECTROSCOPY FOR DIRECT ANALYSES

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## Introduction

Spectrochemical analysis is a powerful instrumental principle for the determination of elemental composition of materials using various methods. Two of them are:

### Hollow Cathode Discharge

**Advantages:**
Fast sputtering of the probe (cathode)
Active environment for excitation of atoms of metals
Wide spectrum of spectral lines

**Drawbacks:**
Preparation of a special sample of the material
The sample is conducting

### Laser Induced Breakdown Spectroscopy (LIBS)

**Advantages:**
No or minimal sample preparation
Possibility to analyze all materials (conducting or non-conducting)
Very small amount of sample – almost "nondestructive"
Possibility for multi-elemental analysis
Possibility for in-situ measurements
Possibility for easy automatization of the measurement process

**Drawbacks:**
Matrix effects
Lower sensitivity than other analytical techniques

**One way to overcome these disadvantages is to combine the LIBS technique with gas discharge for additional amplification of the excitation processes involving the ablated atoms.**

## Aim of the work

**The development and investigation of a novel design for laser ablation-glow discharge for improved elemental analysis**

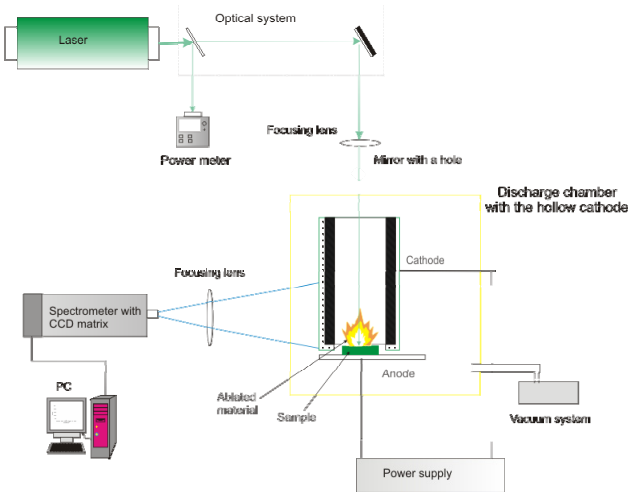
## Hollow cathode discharge assisted LIBS

**Objectives:**

Additional excitation and ionization of the ablated atoms for enhancement of the analytical lines at lower laser pulse energies

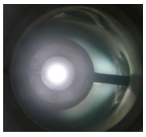
Selectively excitation of chosen lines through Penning excitation and charge transfer collisions

### Set-up

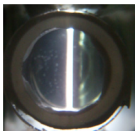



### Experimental conditions

| | |
|---|---|
| Current | 10-30 mA |
| Gas | Helium |
| Pressure | 1-12 Torr |
| Laser pulse energy | 50 mJ |
| Laser pulse duration | 8 ns |

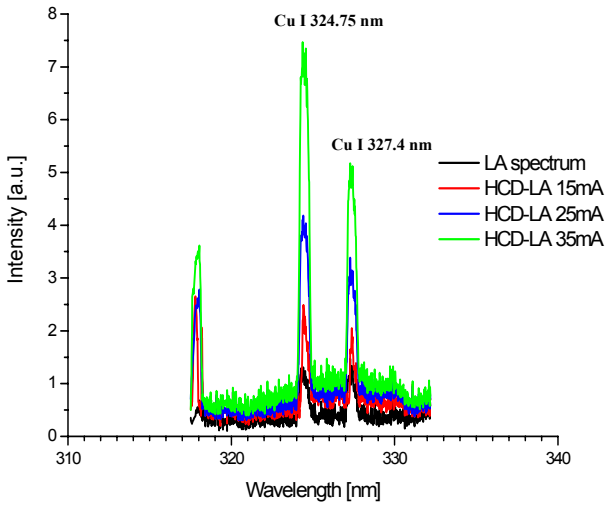


Top view



Axial view

## Results




## Conclusions and future improvements

**A set-up for hollow cathode discharge assisted LIBS set-up is constructed**

**The preliminary results show the possibility of improving the sensitivity of the LIBS technique when the laser ablation takes place in the discharge of the proposed hollow cathode configuration**

**Introduction of pulse hollow cathode discharge at higher currents**

**Further optimization of the discharge parameters – pressure, current, gas composition**

**Cooling of the hollow cathode**

**Multi-elemental analysis**

***Acknowledgments***

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