Ion source based on combined RF frequency powered inductively coupled plasma and hollow cathode discharge

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Radiofrequency powered inductively coupled plasma discharge *(RF-ICP)* is a well-known source of very intensive atomic resonance spectra where resonance lines are up to 10 times more intensive /1/.
There are still problems in production spectra sources for atomic analytical spectroscopy, but ICP is widely applicable in sophisticated experimental research /2,3,4/. Hollow cathode (HC) discharge is broadly used commercially in atomic analytical instrumentation to get atomic resonance spectra line for atoms of many elements of Mendeleev periodic system including hardly volatile elements, e.g. boron. HC lamps alongside atomic emmit sufficiently intensive resonance lines of ionized atoms, which rarely is the case for RF ICP plasma.

Based on our long-term expertise in manufacturing of various light sources /5,6/ we designed the device where both RF-ICP and HC plasma forms a hybrid system. The coil of the RF-ICP source is positioned just next to the cathode of the modified commercial hollow cathode lamp. As a result, we obtained amplification of intensities of emitted HC spectra by 3-5 times for atomic and ionic resonance lines of the selected element. We applied the hybrid system for Cd and Zn because their atomic and ionic resonance lines are closely positioned in the UV spectra region (210-240nm), and it is very suitable to measure and optimize the ratio of the number of atoms to the number of ions in the plasma. Presence of intensive ionic spectra lines evidences the abundance of ions for selected elements in the plasma produced by the hybrid system.

We adapted our hybrid system to serve as an ion source and attached it to our ion beam setup GRIBA (Gothenburg Riga Ion Beam Apparatus) /7/. Currently, the investigations of the positive ion flow extracted from our hybrid ion source are on the agenda in dependence on gas flow, the power of the HC lamp and RF-ICP source, and the geometry of the position of RF-ICP coil and HC.

Our main interest is to apply such a hybrid system for the generation of the boron ion beam, which could be implemented into an innovative implantation device. This work is inspired by Baltic Scientific Instruments /8/, worldwide known as a producer and supplier of ionizing radiation detectors based on high purity Germanium crystals.

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***8.** Baltic Scientific Instruments has specialized in the development and fabrication of devices for spectrometric analysis based on semiconductor and scintillation radiation detectors. http://bsi.lv/en/about-us/*