

MEETING REPORT



SUMMARY OF THE FOURTH INTERNATIONAL CONFERENCE ON ION SOURCES (ICIS 91), BENSHEIM, FEDERAL REPUBLIC OF GERMANY, SEPTEMBER 29–OCTOBER 4, 1991

The ICIS 91 was organized by B. H. Wolf from GSI Darmstadt, Federal Republic of Germany (FRG). For 5 days, ~230 participants discussed problems and applications of ion sources. There were 28 invited talks, and ~180 contributed papers were presented in poster sessions.

Apart from the general trend of radio-frequency or μ -wave-driven ion source plasmas (no cathode problems), some interesting new developments were reported. I. A. Bykovsky and V. N. Nevolin (USSR) surveyed 20 yr of laser-induced ion source plasmas and commercially available machines built in Ukraine for ion beam analysis (resolution 100 nm) or ion implantation for surface modification. R. Sherwood (Switzerland) showed recent results of investigations using a 50-J CO₂ laser. They found lead ions up to 26+ in pulses 5 μ s long and with a repetition rate of 1 Hz, which is well suited for synchrotron injection.

Metallic ions can effectively be produced by metal vapor vacuum arc (MEVVA) ion sources. These MEVVA sources are usually pulsed, but there are some results with direct current (dc) operation where metal ion currents up to 1 A are possible (I. Brown, United States). For metal ion production, negative ion sources also show remarkable results; 10 mA dc or >100 mA has been achieved in pulsed operation of the ion source (Y. Mori, Japan).

Special applications such as microprobes for ion beam analysis or for direct writing or etching of micromechanics or microelectronics are the domain of liquid-metal ion sources (R. Muhle, FRG). For ion etching, one generally uses broad low-energy ion beams (H. C. Scheer, FRG). Large-area intensive ion beams of some 10 keV are needed for ion beam-assisted deposition techniques (W. Ensinger, FRG).

C. Jacquot (France) gave a report on the joint European program for neutral beam injection into tokamaks. Large cusp ion sources generate 4 A of D⁻ ions, which will be accelerated with 1.2 MV. The construction of the power supply particularly demands unconventional solutions.

Ion sources are also used as thrusters in satellites and

space probes. They produce a very low thrust but are maintained from solar panels for a very long period and are well suited for long-term stabilization (H. W. Lob, FRG).

On-line mass separators need ion sources with the highest possible material efficiency. Besides classical discharge sources and μ -wave [electron cyclotron resonance (ECR)] sources, surface ionization ion sources are best suited and, as a new development, laser ion sources (van Duppen, Belgium).

Electron cyclotron resonance ion sources are now widely used to generate high currents of multiple charged ions. By injecting electrons or by coating the source chamber, an improvement of the yield of high-charge states was observed (T. Antaya, MSV). Special source optimization to an afterglow mode of 100 μ A of ²⁸⁺Pb during a pulse of 0.4 ms and a repetition rate 1 to 4 Hz have been reported (P. Sortais, France).

Even higher charge states with moderate intensities can be produced in electron beam ion sources (EBIS) and are mainly used for atomic physics experiments. E. Donets (USSR) gave a summary of a workshop on EBIS ion sources recently held in Dubna, USSR.

In an electron beam ion trap for extremely high charge states (⁸⁰⁺Th and ⁷⁰⁺U) has been created, stored, and used for spectroscopic investigations (D. Schneider, United States). Until now, such highly charged ions could only be generated by the stripping of high-energy (>100 MeV/amu) heavy ion beams.

Lively discussions were held during one afternoon of the conference by specialized groups on MEVVA ion sources, large-area ion sources and extraction calculations, high-current ion sources for ion implantation, and laser ion sources.

The conference proceedings was published in *Rev. Sci. Instrum.*, **63**, 4 (1992).

The next conference of this series, ICIS 93, will be held at the end of August 1993, in Beijing, People's Republic of China.

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December 5, 1991