Brilliant light source based on a barrier discharge

Many analytical applications require light sources of high brilliance in the ultraviolet to visible spectral range. According to the current state of the art, deuterium- or xenon-based high-pressure lamps are commonly used for this purpose. A significantly higher brilliance over an additionally broader spectral range can be achieved with beam sources in which a laser excites a plasma to glow. For some applications, however, both the high-pressure lamps and the laser-driven source are not sufficiently compact or cost-effective. This problem is currently being addressed with a new approach that uses the light from a stationary single-filament barrier discharge. High brilliance is achieved by coupling out the light along the filament axis.

Efficiencies of up to 50 percent

The figure below shows the principle of the experimental setup. The electrode system consists of a pointed HV electrode, which establishes the position of the filament, and either a transparent or apertured metallic ground electrode, which is used to outcouple the light. When an HV AC voltage is applied, short-lived plasma filaments are formed in each half-wave, which can be used to efficiently convert electrical power into light. For example, efficiencies of up to 50 percent are possible with excimer gases.

Mobile probe for pollutant analysis in wastewater

For operation with nitrogen, an emission spectrum with spectral wave packets in the range of approx. 200 to 400 nm could be demonstrated. The bandwidth of the individual wave packets here is typically < 5 nm. Based on the available data, a source thus appears feasible that can emit about 0.4 mW/sr in a wave packet at a brilliance > 1 mW/mm²/sr with an average electrical input power of 5 W. A possible field of application is the on-line 2D fluorescence analysis of pollutants in wastewater, where the characteristic fluorescence radiation is excited at several wavelengths. Thanks to the single-filament light source, a compact and cost-effective probe for mobile use of this application can be built.

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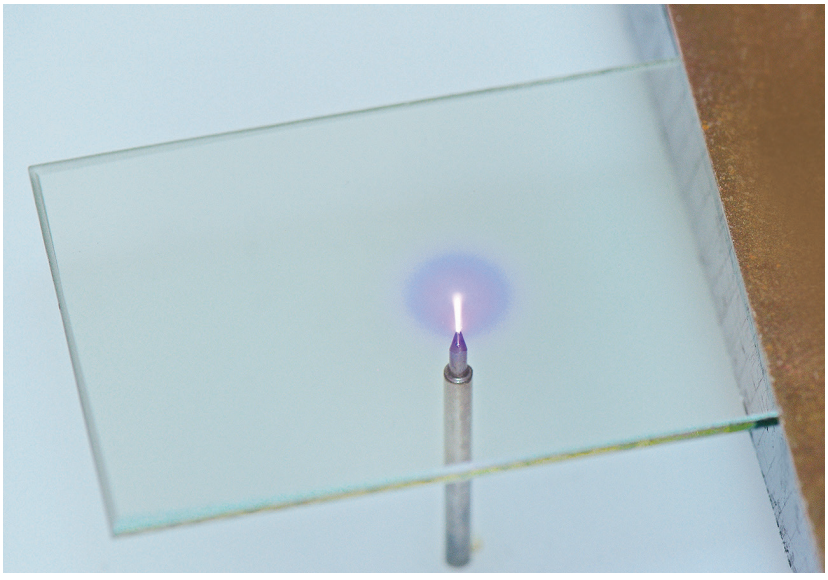

Single filament barrier discharge with transparent electrode.