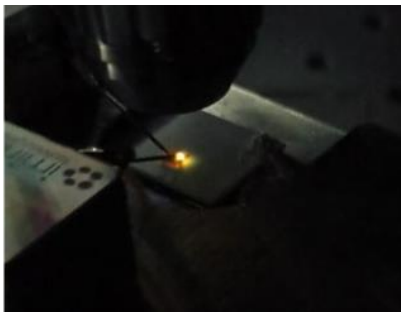
Diamond Schottky LED

LEDs for harsh environments

Invention

LEDs today are used in a variety of applications, such as lighting, data transmission and biological processes. While they are usually made of semi-conducting material, this material is unsuitable for some chemical and biological applications where costly insulation is needed that, in turn, impacts light emission. With this invention, the University of Siegen has developed a light-emitting diode with a lateral power flow. What makes it special is that the active material is diamond, and one of the two electrical contacts is a Schottky contact. The primary layer is doped diamond with embedded color centers. Color centers are crystal defects that can emit light they are also referred to as luminescent defects. By combining different color centers, an LED can be turned into a source of white light or be adapted to specialized applications.



Diamond Schottky LED operating at a temperature of 150 °C. The visible light is being emitted from nitrogen-based color centers.

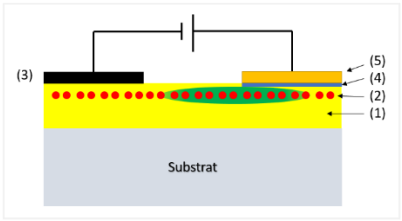


Diagram of the structure of an LED:
(1) Phosphorus-doped diamond
(2) Color center acting as lighting medium
(3) Ohmic contact
(4) Hydrogen passivation
(5) Schottky contact on passivation

Commercial Opportunities

Due to its special properties and diamond-based structure, this LED is designed especially for harsh environments with high temperatures and pressure levels where conventional LEDs cannot be used. Use in metrological applications in particular is also feasible.

Current Status

An experimental proof-of-concept has been built that demonstrates basic functionality. An application has been submitted to the German Patent and Trademark Office, with subsequent applications in other countries possible in the priority year or as part of a later PCT application. We are offering interested companies the opportunity to license and continue to develop this technology with the inventors at the University of Siegen.

Relevant Publications

Robust luminescence of the silicon-vacancy center in diamond at high temperatures, S. Lagomarsion et al., AIP Advances 5, 127117 (2015)

Ultrabright single-photon source on diamond with electrical pumping at room and high temperatures, D. Yu Fedyanin, M. Agio, New J. Phys. 18, 073012 (2016)

Silicon-vacancy color centers in phosphorus-doped diamond, A.M. Flatae et al., Diam. Relat. Mater. 105, 107797 (2020)

An invention of University of Siegen.

Competitive Advantages

- High temperature resistance
- High pressure resistance
- High chemical stability
- Suitable for harsh environments
- Choice of color centers possible
- Extensive area of application
- Suitable for high-speed circuits

Technology Readiness Level

1 2 3 4 5 6 7 8 9

Experimental proof of concept

Industries

- Electronics

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