BRUCE 80

The 2nd International Workshop on Magnetic Excitations in Semiconductors: Bridges to the Next Decade

A Celebration of the 80th Birthday of

Professor Bruce D. McCombe

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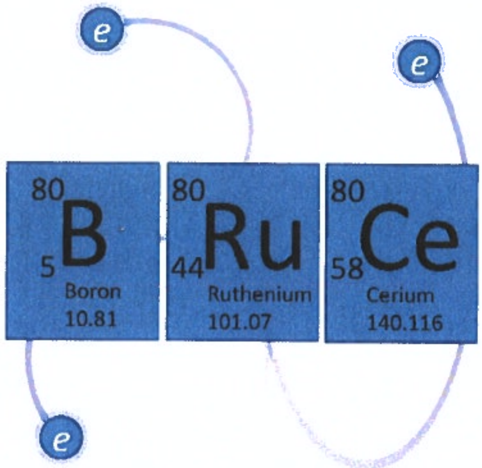

Session 4: Legends (40+ years)
Saturday, July 14, 2018

Talk #2
15:30 - 15:45

Interband Cascade Ring Lasers

Martin Holzbauer,[1] Robert Weih,[4] Sven Höfling,[2,3] Werner Schrenk,[1] Johannes Koeth,[4] Erich Gornik,[1] and Gottfried Strasser[1]

[1] *Institute of Solid State Electronics and Center for Micro- and Nanostructures, TU Wien, Vienna, Austria*
[2] *Technische Physik, Physikalisches Institut and Wilhelm Conrad Röntgen-Research Center for Complex Material Systems, University of Würzburg, Germany*
[3] *SUPA, School of Physics and Astronomy, University of St Andrews, United Kingdom*
[4] *nanoplus Nanosystems and Technologies GmbH, Germany*

This talk will describe our recent work in the field of interband cascade lasers [1]. Interband cascade lasers are infrared light sources that combine conduction-to-valence band optical transitions with an in-series connection of multiple active regions. Hence, they can be seen as hybrids between conventional laser diodes and quantum cascade lasers. Interband tunneling across a type-II band alignment between InAs and GaSb layers allows carrier recycling and to achieve differential quantum efficiencies above unity. With an external bias a semimetallic band alignment is created, where electrons and holes are generated internally. Interband cascade lasers are power-efficient semiconductor devices that cover the infrared spectral region between 2.8 and 11μm [2,3]. We demonstrate a compact substrate-emitting interband cascade laser with a ring-shaped cavity [4]. The light is out-coupled in vertical direction with a second-order distributed feedback grating. A pulsed threshold current density of 0.75 kA/cm^2 is measured at 20°C for a device emitting at 3.7μm. Finally, we compare the projected nearfields of interband and intersubband cascade ring lasers. While the quantum cascade laser shows an azimuthal orientation, its interband counterpart features a radial polarization of the nearfield. The difference is caused by the nature of the optical transition. Quantum cascade lasers are subjected to the intersubband selection rule, which favors transverse magnetic polarized light. On the other hand, the recombination of electron and heavy-hole leads to transverse electric polarized light emitted from interband cascade lasers.

1. R. Q. Yang, *Superlattices Microstruct.* **17**, 77 (1995).
2. I. Vurgaftman *et al.*, *J. Phys. D: Appl. Phys.* **48**, 123001 (2015).
3. R. Weih *et al.*, *Appl. Phys. Lett.* **105**, 071111 (2014).
4. M. Holzbauer *et al.*, *Appl. Phys. Lett.* **111**, 171101 (2017).