Mid-Infrared Semiconductor lasers

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Abstract

Over the last two decades, the mid-infrared has seen the development of a new generation of semiconductor laser sources that combine high optical power, low-dissipation and wavelength agility. At present, three technologies have been especially successful, based on type I interband transition, interband cascade and intersubband cascade. Each technology presents specific advantages in different wavelength regions.

Among recent developments, especially interesting for spectroscopy are the development of quantum cascade optical frequency combs because they offer a new paradigm for broadband spectroscopy.

The lecture will discuss both the basic physics and the key feature of this various technologies, as well as give an overview of its newest developments.

Lecture: 4x 45 min

- Semiconductor lasers:
    - General characteristics: Light-current, wallplug
      Temperature variation of the characteristics

- Mid-infrared lasers: Interband and intersubband devices
    - Band structure
    - Band engineering
    - Heterostructure and electron states

    Device optimization:
    - Waveguide losses
    - Optical confinement
    - Electron and hole confinement
    - Auger processes
- Intersubband gain
    - Active region design
    - Design optimization:
        - Active region design
        - upper and lower state lifetimes
        - doping
        - Automated techniques

- Power: Wallplug efficiency, beam profiles and dissipation
    - General concepts
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- Tunable devices
    - Fabry Perot
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- Optical frequency combs