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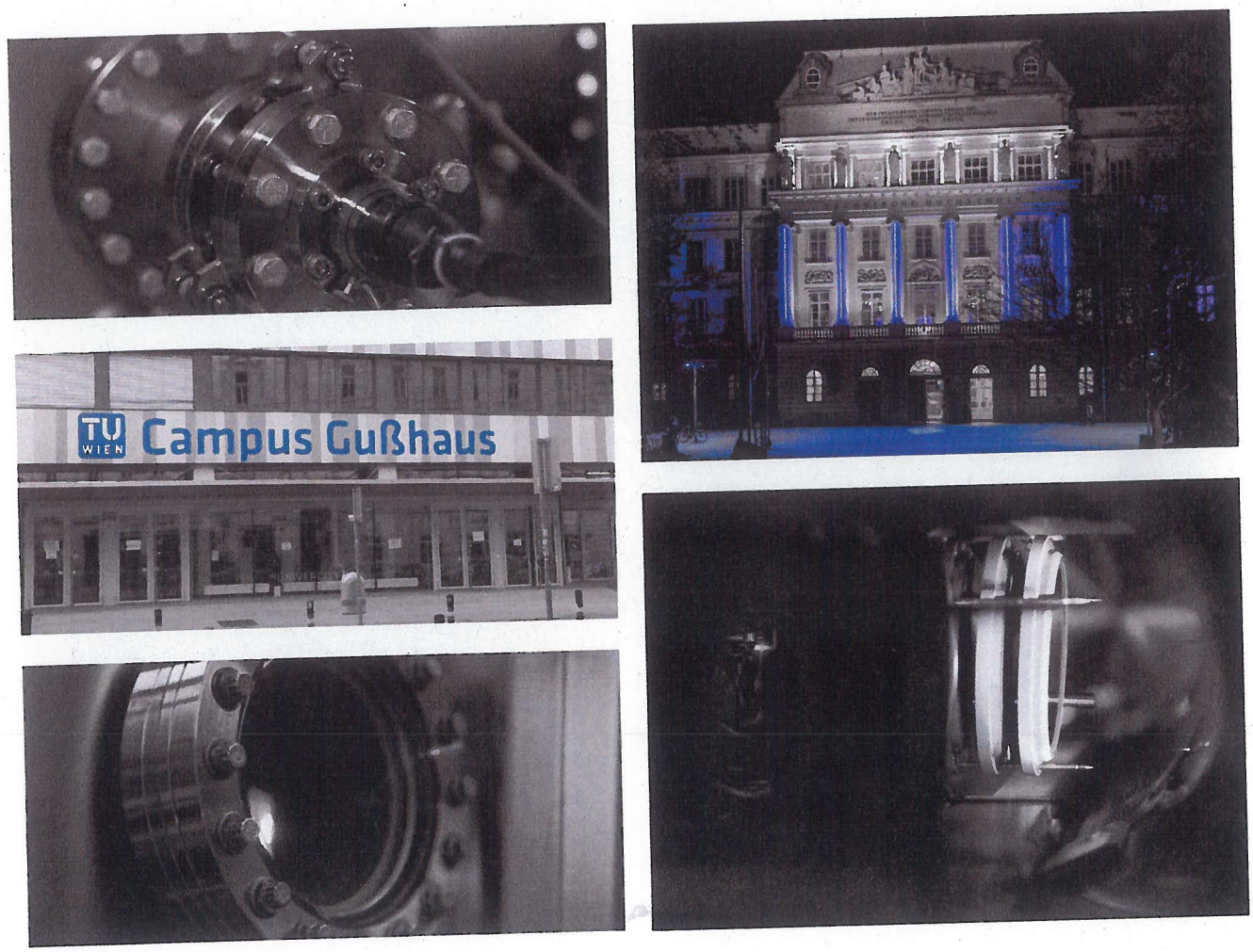

The polarization of ring interband cascade lasers

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The interband cascade laser (ICL) [1,2] is a hybrid between conventional photodiodes and quantum cascade lasers. Thus it combines the long carrier lifetimes of bandgap diodes with the carrier recycling scheme utilized in intersubband cascading lasers. Due to the semimetallic interface between InAs and GaSb, electrons and holes are generated internally. Carriers are recycled via interband tunneling from the valence to the conduction band. This allows achieving differential quantum efficiencies greater than one. Or in other words, each injected carrier can emit multiple photons. The low input power required for lasing makes the ICL an ideal candidate [3] for mobile applications with low power consumption.

We present an ICL fabricated into a ring shaped cavity. A second-order distributed feedback grating is used to couple the light out in vertical direction. The grating is etched into the uppermost cladding layers and completely covered by a gold metallization. In this configuration the generated light is diffracted towards the GaSb substrate. For a device with 400µm outer diameter and 10µm waveguide width, we measured a pulsed threshold current density <1kA/cm² at room temperature. The ring ICL emits at a wavelength ~3.7µm. The recombination across the bandgap between states in the conduction band and empty states in the heavy-hole valence band dominate the polarization selection rule for quantum well structures. Therefore the gain in ICLs favors TE polarized light. We expect a different radiation pattern compared to previous results on ring quantum cascade lasers [4]. Fig.1 (a)-(c) shows the measured nearfields on the substrate-side of the ring ICL. If a polarizer is inserted between the laser and the bolometer camera, the electric field is blocked in the direction parallel to the wire grid. From measurements with different rotation states of the polarizer we conclude that the electric nearfield of the ring ICL has a radial orientation, as shown in Fig.1 (d).

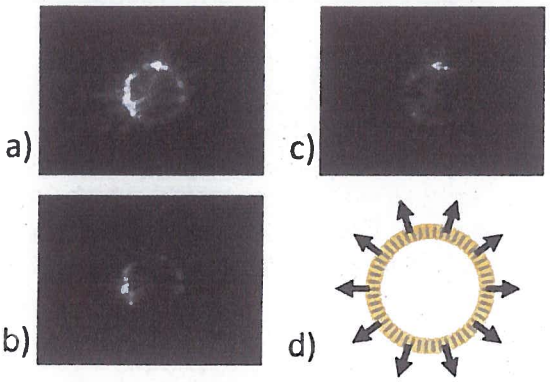

Fig.1: (a) Unpolarized nearfield measured with a bolometer camera. (b) Vertical orientation of the wire grid. (c) Horizontal orientation and (d) resulting polarization of the electric field.

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