

# Towards the understanding of the dynamics and the Raman effect of strained germanium lasing

*Tuesday, 29 October 2019 17:30 (50 minutes)*

Thanks to its CMOS compatibility and “near” direct bandgap, Germanium (Ge) has been for long in the race for the development of a fully Si-compatible light source, as an alternative to the traditional III-V-on-Si laser integration. The offset  $\Delta E = E(\Gamma) - E(L) = 140$  meV of Ge can be reduced by tensile strain and/or by alloying with Sn, increasing the radiative recombination efficiency. GeSn was shown to be a successful platform for lasing back in 2015 [1] and a rapid development of the field pushed the operational limit almost to room temperature [2]. However, the first demonstration of lasing in elemental strained Germanium was only recently achieved by our group in PSI [3]. We showed highly efficient lasing between 3.20 and 3.66  $\mu\text{m}$  in Ge microbridges highly strained along the  $\langle 100 \rangle$  direction, up to 100 K and upon pulsed excitation of 100 ps. Interestingly, lasing could not be achieved in alike conditions under continuous wave (CW) excitation, indicating that, on the contrary of many previous theoretical models, the band gap is only marginally closed even at almost 6 % of strain. We thus propose that lasing is obtained thanks to a non-equilibrium distribution of the carriers, which evidentially takes place on a time scale longer than the excitation pulse length, and also only at sufficiently low temperatures. We are currently investigating the scattering time of the carriers between the  $\Gamma$  and L valleys by studying the lasing response of the microbridge under a pump-probe like excitation scheme. We will also show the appearance of Raman lasing, which seems to compete with the traditional population inversion lasing.

## Position

Phd

**Primary author:** Mr ARMAND PILON, Francesco Taro

**Co-authors:** Dr LYASOTA, Alexey (Laboratory for Micro- and Nanotechnology, Paul Scherrer Institut, 5232 Villigen, Switzerland); Dr NIQUET, Yann-Michel (Univ. Grenoble Alpes, CEA, IRIG-DePhy, 38054 Grenoble, France); Dr REBOUD, Vincent (Univ. Grenoble Alpes, CEA, LETI, 38054 Grenoble, France); Dr CALVO, Vincent (Univ. Grenoble Alpes, CEA, IRIG-DePhy, 38054 Grenoble, France); Dr PAUC, Nicolas (Univ. Grenoble Alpes, CEA, IRIG-DePhy, 38054 Grenoble, France); Dr WIDIEZ, Julie (Univ. Grenoble Alpes, CEA, LETI, 38054 Grenoble, France); Dr HARTMANN, Jean-Michel (Univ. Grenoble Alpes, CEA, LETI, 38054 Grenoble, France); Dr CHELNOKOV, Alexei (Univ. Grenoble Alpes, CEA, LETI, 38054 Grenoble, France); Prof. FAIST, Jerome (Institute for Quantum Electronics, ETH Zürich, 8093 Zürich, Switzerland); SIGG, Hans-Christian (Paul Scherrer Institut)

**Presenter:** Mr ARMAND PILON, Francesco Taro

**Session Classification:** Poster session

**Track Classification:** Poster