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and with exactly known limits in the weak- and strong coupling regime. We further show complete polaron dispersion curves. The DMC calculations reproduce very well the different behavior seen in 2D and 3D: in 2D the energy curve approaches the continuum edge asymptotically from below, whereas in 3D it reaches the continuum edge at a finite critical wave vector. The accuracy of the obtained polaron dispersions is verified with very narrow upper and lower bounds.

[1] A.S. Mishchenko *et al.*, *Phys. Rev. B* **62**, 6317 (2000)

COND-5 TALK 15:00-15:15 TUESDAY, SEP 11 HS P2

Three Dimensional Nanostructuring of Silicon

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Silicon nanostructures have attracted lots of interest for their outstanding and tunable optoelectronic properties. Three dimensional control over their geometry is expected to lead to significant advances in a variety of fields such as photonics, solar fuel generation, photovoltaics or sensing. Unfortunately, this is still a difficult task. We will report on our recent progress to control the growth of well-defined metal nanostructures around single crystalline nanowires produced via metal assisted chemical etching (MACE).[1] The technique is based on simple chemical and electrochemical approaches that were developed previously[2] and can produce homogeneous large scale (ca. 25 mm^2) metal-silicon wire arrays with a sub-10 nm resolution.

[1] F. J. Wendisch, R. Oberreiter, M. Salihovic, M. S. Elsaesser, and G. R. Bourret, *ACS Appl. Mater. Interfaces* **2017**, 9, 3931-3939
[2] T. Ozel, G. R. Bourret and C. A. Mirkin Nat. Nanotech. **2015**, 10, 319-324

COND-6 TALK 15:15-15:30 TUESDAY, SEP 11 HS P2

Mode-locked interband cascade lasers

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In this work, we demonstrate a frequency comb source based on actively mode-locked interband cascade lasers (ICL), thereby solving two current issues connected to on-chip miniaturization. By utilizing ICLs, we move to a technology with a much smaller power requirement and thermal dissipation to enabling battery driven miniaturized sensors in future. Simultaneously, ICL technology allows straightforward on-chip detection capabilities [1].

Optical frequency combs are light sources whose spectra consist of equally spaced modes. Frequency combs based on QCLs were one of the first compact source in the mid-infrared [2] and their large potential for spectroscopic applications is already evident [3, 4]. We utilize a two-section device consisting of a long gain and a short absorber section that is optimized for RF injection. Active modulation of the short absorber section allows control over the cavity loss and, together with the

long upper state lifetime of ICLs, enables to lock the modes of the cavity to obtain picosecond pulse emission. Observing a narrow beatnote at the round trip frequency can serve as a first indication that at least some of the modes emitted by the laser posse a fixed phase relation.

A much better technique is the so called intermode beat spectroscopy [2]. Thereby, an interferogram of the optical beatnote signal is recorded using a fast detector and a RF spectrum analyzer. It allows to measure the spectrally resolved coherence and thus is a perfect technique to proof frequency comb generation. To proof mode-locking we go one step further and apply a phase sensitive technique to obtain both the amplitude and phase of the beating between each pair of frequency comb lines. Also referred to as shifted wave interference Fourier transform spectrum (SWIFTS) [5], this method allows the reconstruction of the time domain signal emitted by the laser and thus gives a clear proof that our laser is a fundamentally mode-locked frequency comb.

[1] H. Lotfi, L. Li, S. M. S. Rassel, R. Q. Yang, C. J. Corrége, M. B. Johnson, P. R. Larson, and J. A. Gupta, "Monolithically integrated mid-IR interband cascade laser and photodetector operating at room temperature," *Applied Physics Letters* **109**, 151111 (2016).
[2] A. Hugi, G. Villares, S. Blaser, H. C. Liu, and J. Faist, "Mid-infrared frequency comb based on a quantum cascade laser," *Nature* **492**, 229-233 (2012).
[3] G. Villares, A. Hugi, S. Blaser, and J. Faist, "Dual-comb spectroscopy based on quantum-cascade-laser frequency combs," *Nature Communications* **5**, 5192 (2014).
[4] https://irsweep.com.
[5] D. Burghoff, Y. Yang, D. J. Hayton, J.-R. Gao, J. L. Reno, and Q. Hu, "Evaluating the coherence and time-domain profile of quantum cascade laser frequency combs," *Optics Express* **23**, 1190 (2015).

COND SESSION II 16:00-17:30 TUESDAY, SEP 11 HS P2

COND-7 TALK 16:00-16:15 TUESDAY, SEP 11 HS P2

In-Situ Studies on the Formation and Tunable Properties of Nanoporous Metals Produced by Electrochemical Dealloying

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Dealloying is a selective (electro-)chemical etching process, which removes the less noble component from an alloy, resulting in a sponge-like structure of the more noble component [1]. In such a way, nanoporous (np) metal structures can be generated in quasi unrestrained (three dimensionally macroscopic) shape, which are attractive for basic research as well as technology applications such as sensing, energy storage or catalysis.

The formation of the nanoporous structure during dealloying is studied by in-situ resistometry, thus providing the first dynamical method for monitoring the etching of macroscopic samples. Using np-Au and np-Pt as examples, we find a resistance increase by about three orders of magnitude due to porosity evolution and concomitant oxide formation. We introduce a model, which allows an evaluation of the etching front propagation ('primary dealloying') as well as the status of the already porous structure ('secondary dealloying'). [2]