Prize Talk PRV I Mon 13:15 H 1012

Fabrication and characterization of spin Hall nano-oscillators

— •Toni Hache[1,2], Tillmann Weinhold[1,3], Kai Wagner[1,3], Nana Nishida[1], Sri Sai Phani Kanth Arekapudi[2], Tobias Hula[1], Olav Hellwig[1,2], and Helmut Schultheiss[1,3] — [1]Helmholtz-Zentrum Dresden - Rossendorf, Institut für Ionenstrahlphysik und Materialforschung, 01328 Dresden, Germany — [2]Institut für Physik, TU Chemnitz, D-09107 Chemnitz — [3]TU Dresden, 01328 Dresden, Germany — Laureate of the Georg-Simon-Ohm-Prize

Spin-Hall nano-oscillators (SHNOs) are modern auto-oscillation devices. Their simple geometry allows for an optical characterization by Brillouin-Light-Scattering microscopy at room temperature. Here we report on the observation of auto-oscillations in constriction based SHNOs. These are devices where the current density is increased locally due to lateral confinement. Hence, the spin current generated by the spin Hall effect can create well defined hot-spots for auto-oscillations. We present BLS measurements of auto-oscillations in Co60Fe20B20(5nm)/Pt(7 nm) based samples. The precession amplitude in these samples can be driven far from equilibrium, resulting in clear nonlinear signatures in the spinwave spectra. The spatial distributions of the observed modes and current dependencies are shown. Furthermore it is shown how the auto-oscillations can be locked to an external harmonic stimulus realized by an added microwave current. Moreover, a new type of SHNO using spin textures without applied external magnetic field is referenced.

Prize Talk PRV II Tue 13:15 H 0105

Single-Atom Catalysis: An Atomic-Scale View

— •Gareth Parkinson — Institute of Applied Physics, TU Wien, Vienna, Austria — Laureate of the Gaede Prize

Single-atom catalysis is a rapidly emerging area of research that aims to maximize the efficient usage of precious metals through "single atom" active sites. Although catalytic activity has been demonstrated for several single-atom catalyst systems, an inability to accurately characterize the catalyst based on single atom active sites ensures that that the field remains controversial, and little is really known about how a single atom adsorbed on a metal oxide support catalyzes a chemical reaction. In this lecture, I will describe how we are addressing the crucial issues of stability and reaction mechanism using a surface science approach. The work is based on the magnetite (001) surface, which exhibits an unusual reconstruction based on subsurface cation vacancies. The surface stabilizes ordered arrays of metal adatoms (of almost any variety) with a nearest neighbor distance of 0.84 nm to unprecedented temperatures as high as 700 K. Crucially, because the geometry of the adatoms is uniform and precisely known, reactivity experiments are performed on a well-defined model system, and theoretical calculations can be performed to shed light on the mechanisms at work. Several examples of our recent work will be used to illustrate the trends discovered to date, including how strong CO adsorption destabilizes Pd and Pt adatoms leading to rapid sintering, and how extraction of lattice oxygen from the metal-oxide is central to catalytic activity in the CO oxidation reaction.

Prize Talk PRV III Wed 13:15 H 0105

Ultrafast transmission electron microscopy

— •Sascha Schäfer — Carl von Ossietzky Universität Oldenburg, Germany — Laureate of the Walter-Schottky-Prize

Ultrafast transmission electron microscopy (UTEM) provides a unique experimental tool to study ultrafast dynamics at the nanoscale, combining the temporal resolution of a pump-probe approach with the spatial resolution of electron microscopy. In UTEM, femtosecond electron pulses stroboscopically probe the transient state of excited solid-state nanostructures. Depending on the electron imaging geometry, local ultrafast dynamics in structural, electronic and spin degrees of freedom are accessible, so that UTEM may potentially yield a comprehensive understanding of ultrafast nanoscale dynamics in complex systems.

In this talk, I will give an overview on our recent progress in the Göttingen UTEM project, covering instrumental aspects, such as the development of coherent photo-driven electron sources [1], as well as emerging applications. Examples will include the imaging of ultrafast structural [2] and magnetic dynamics [3,4], the coherent optical control of free-electron states in confined light fields [5-7] and the generation of attosecond electron pulse trains [7].

[1] A. Feist et al., Ultramicroscopy 176, 63-73 (2017). [2] A. Feist, Struct. Dyn., accepted (2017); arXiv:1709.02805. [3] T. Eggebrecht, Phys. Rev. Lett. 118, 097203 (2017). [4] N. Rubiano da Silva, submitted, arXiv:1710.03307. [5] A. Feist et al., Nature 521, 200-203 (2015). [6] K. E. Echternkamp et al. Nature Phys. 12, 1000-1004 (2016). [7] K. E. Priebe et al., Nature Photonics 11, 793-797 (2017).

Prize Talk PRV IV Thu 13:15 H 0105

Let's twist again – Magnetic Skyrmions

— •Karin Everschor-Sitte — Institute of Physics, Johannes Gutenberg University Mainz — Laureate of the Hertha-Sponer-Prize

The magnetisation in simple ferromagnets is often rather unspectacular, as basically all magnetic moments are aligned in the same direction. However, in systems with competing interactions that favour different alignments of the magnetisation, more complicated textures can arise. Discovered experimentally in 2009, magnetic skyrmions exhibit a topologically nontrivial twist which gives rise to interesting physical properties and magnetisation dynamics well-suited for spintronic applications. Central challenges towards skyrmioncs include their efficient creation and manipulation. Within this talk I discuss how to reproducibly create and manipulate magnetic skyrmions with electric currents without the need for specialised setups. We demonstrate that it is possible to create skyrmions and other magnetic textures in ferromagnetic thin films in the absence of traditional chiral interactions. This allows for the coexistence of left and right handed skyrmions which dynamically twist into each other over and over again.