

Christina Birkel

Assistant Professor, Molecular Sciences
Arizona State University



Expanding the compositional and microstructural space of layered and 2D materials (MAX phases and MXenes)

We are facing many exciting challenges in materials science and being able to produce high-quality and new materials plays a key role in unraveling the almost endless list of open research questions and developing new technologies. My group focuses on the synthesis of new layered compounds (MAX phases) and 2D materials (MXenes). MAX phases are ternary transition metal-based carbides and nitrides that crystallize in a layered structure with space group $P6_3/mmc$. They are unique compounds because they can be described as ceramic metals (they are electrically and thermally conductive) and metallic ceramics (showing high temperature and oxidation resistance). Chemical exfoliation of the MAX phases leads to a relatively young class of 2D materials, the so-called MXenes, which have left almost no potential area of application untouched and will benefit from a greater chemical diversity amongst their family members. Traditionally, MAX phases are prepared by high-temperature solid-state methods, oftentimes under pressure, and the formation of side phases (binary carbides/nitrides and intermetallics) is very common and a challenge in the materials chemistry community. In this talk, I will show wet chemical-based synthesis strategies to access MAX phases that lead to new compositions as well as novel microstructures of these types of materials. For example, we have recently prepared MAX phase Cr_2GaC in the form of microwires, thick films and (hollow) microspheres. We study their (local) structure by X-ray and neutron diffraction and focus on their complex and unique transport properties.

Christina Birkel is an Assistant Professor in the School of Molecular Sciences at Arizona State University and holds a joint professorship position in the Department of Chemistry and Biochemistry at the Technische Universität Darmstadt, Germany. Prior to her current position (since 2019), she was an Athene Young Investigator leading a Junior Research group at the Technische Universität Darmstadt where she also completed her Habilitation in late 2018. Leading up to her independent career, she joined the group of Prof. Galen Stucky at the University of California, Santa Barbara, for her Postdoctoral work (2011 – 2013) that was funded through a Feodor Lynen Research Stipend by the Alexander-von-Humboldt Foundation. In 2010 she successfully defended her PhD thesis (summa cum laude, MAINZ award granted for an outstanding PhD thesis) under the supervision of Prof. Wolfgang Tremel at the Johannes Gutenberg-University of Mainz, Germany, holding a stipend of the Graduate School of Excellence (Materials Science in Mainz). Dr. Birkel is a solid-state inorganic/materials chemist by training and her group focuses on the synthesis of functional inorganic materials. They strive to prepare new materials and/or manipulate known ones – for example, their morphology and processability – to meet the ever-growing demands of existing and new technologies, particularly in the energy sector.

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Registration is required. [RSVP here.](#)

Questions? Contact elena.lindstrom@northwestern.edu.