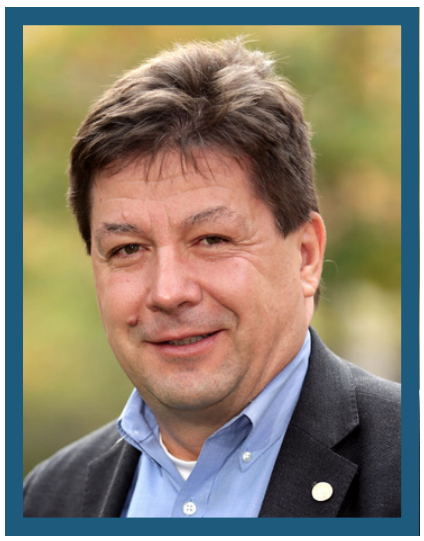
HIGHLANDS IN CHEMISTRY SEMINAR SERIES



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"Bottlebrush elastomers and gels: Programming tissue-mimetic properties by architecture"

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Bottlebrush macromolecules are resourceful building blocks for constructing tissue-mimetic materials with sought after combinations of softness, damping, swelling, and adhesion. Densely grafted side chains define physical properties in two ways: (i) they disentangle network strands and (ii) they increase strand persistent length. The first trait alleviates constraints for lowering the crosslink density, enabling supersoft and super-swelling polymer networks that closely match soft tissues like brain and jellyfish. The second trait-variable persistence length- controls elastic modulus, strain-stiffening, and relaxation times. By architecturally adjusting the size and flexibility of brush-like network strands, we can create materials possessing oxymoronic property combinations, such as being soft-yet-firm, elastic-yet-dissipating, and stiff-yet-stretchable. Recently, we have explored brush macromolecules with active backbones that synergize with the passive side chains to generate novel materials such as super swelling-yet-resilient hydrogels and bottlebrush liquid crystals. In short, the design-by-architecture approach empowers programmable variations of a network's modulus, damping factor, swelling ratio, and relaxation time independently of one another, meeting the diverse needs of both medical and non-medical technologies.