**Haugstad research**

**Scanning probe methods**

**Measurement science & instrument operation**
- Probe-sample interaction, methods to differentiate interfacial forces (e.g., capillary, vdW)
- Resolution (spatial, temporal, force/energy), signal-to-noise, surface tracking, image quality
- Custom methodologies (modulation methods, parameter variation/ramping, multidata)
- Data reduction, correlational/Fourier analysis, data interpretation, modeling (analytic, numerical, FEA)

**Condensed matter**
- Soft, fluidic, steric
- Thin films/coatings, interfaces
- Mixtures (for application purposes, e.g., drug+polymer, polymer+surfactant)
- Microscale devices and constructs (e.g., from 2D materials)
- Polarizability, surface potential, capacitance, charging
- Defects, problematic samples (distinguishing “good” from “bad”)

**Nanoscale mechanics, tribology, rheology**
- Quantitative material properties (e.g., modulus (kPa to GPa), coefficient of friction)
- Environmental: gas/liquid immersion
- As contrast mechanisms (local variations)
- Fundamental physics: nonlinearity, activated responses (functions of rate, T), entropic vs enthalpic, fluctuations
Haugstad research: six methodological themes

I. Complementarity of imaging methods: AFM, confocal Raman, SEM, TEM and scattering (Xray, ion) on complex materials; under aqueous immersion.


II. AFM contrast mechanisms: crystallinity, modulus, viscosity, capillarity, adhesion, dielectric constant, surface potential, magnetization, conductivity.

G. Haugstad, AFM: Basic modes to Advanced Applications (Wiley, 2012). With C. Macosko research group, CEMS.

III. Nanoscale thermo/kinetics and general response functions: crystallization, glass transition, melting, diffusion, hydration, polarizability; as a function of rate, bias, temp., humidity.

With Boston Sci and A. McCormick, CEMS.

IV. Liquidy condensed matter: (i) Imaging; (ii) viscoelasticity of gels.

With L. Francis group, CEMS.


VI. Nanomechanics of microscale devices (e.g., bridges of graphene, CNT).