Dynamic Atomic Force Microscope for Viscoelasticity of Single Folded Domains of Proteins

Dr. Shivprasad Patil

Indian Institute of Science Education and Research, Pune

The advent of the atomic force microscope, along with optical tweezers, ushered in a new eld of single molecule force spectroscopy, wherein the response of a single protein or a macromolecule to external mechanical perturbations is measured. Controlled forces ranging from pN to nN are applied to measure unfolding force distribution of a single protein domain. In a clamp type experiment, the folded protein is subjected to a constant force to measure the unfolding time distribution.

Simultaneously, there were e orts to measure elastic and viscous response of a single domain by applying sinusoidal forces and measuring resulting deformations produced in a bid to quantify its viscoelasticity. The deformation's phase lag with respect to the applied force provides the elastic and viscous response of the protein, akin to oscillatory rheology. Despite numerous technical advances in AFM, an artefact-free measurement of a folded protein's viscoelasticity largely remains a challenge. In this talk, I review e orts to measure viscoelasticity of proteins using dynamic AFM, identifying pitfalls that make these measurements elusive. Finally, I discuss our new promising method, which reported viscoelasticity of a folded protein and reasons, that enabled such a measurement for the rst time [1].

References:

1. Surya Pratap S. Deopa, Shatruhan Singh Rajput, Aadarsh Kumar, and Shivprasad Patil, Direct and Simultaneous Measurement of the Sti ness and Internal Friction of a Single Folded Protein, The Journal of Physical Chemistry Letters 2022 13 (40), 9473-9479, DOI: 10.1021/acs.jpclett.2c02257

Electrochemistry ‘Weds’ Materials: Welcome to Celebrate Perfect Match!

Dr. Santosh Haram

Department of Chemistry, Savitribai Phule Pune University, Ganeshkhind, Pune 411007.

Email: Santosh.haram@unipune.ac.in

Recent erratic weather has hinted us that if we continue enjoying a fossil fuel-based economy in this century and ignore the ecology, then our future generation would not forgive us. Thus, efforts need to be put to use in-house knowledge in the material science to develop indigenous renewable energy based technologies. Recent progress in low temperature composite nanomaterials used in third generation solar cells, fuel cells and electrolysers has given us renewed hopes in becoming self reliable in energy sector. All these devices are based on electron transfer reaction at the interface. Therefore, an electrochemist has major role to play in analyzing them. This tutorial talk put forward few ideas about use of classical electrochemical techniques used in contemporary Material Science. Among various techniques, scanning Electrochemical Microscopy (SECM) technique is a recent advancement which will be described in more details.

References:

(1) Mapping of Electrocatalytic Sites on a Single Strand of Carbon Fiber Using Scanning Electrochemical Microscopy (SECM) VS Joshi, SK Haram, A Dasgupta, GVP Kumar, The Journal of Physical Chemistry C 116 (17), 9703-9708

(2) Methanol oxidation reaction on Pt based electrocatalysts modified ultramicroelectrode (UME): Novel electrochemical method for monitoring rate of CO adsorption, VS Joshi, DC Poudyal, AK Satpati, KR Patil, SK Haram, Electrochimica Acta 286, 287-295