Indian Institute of Technology Kanpur

C. N. R. Rao Lecture

6.15 PM, Friday, 15th February 2019, Venue: LH 17

Professor Animangsu Ghatak
Department of Chemical Engineering, IIT Kanpur

Title: Adhesion and Fracture of Soft Materials

Abstract

Fracture of soft solids like an elastomer, a gel or a biological tissue is encountered in many different applications, e.g. cutting vegetables with the sharp edge of a knife at the mundane setting of a kitchen, puncturing with a sharp object like a hypodermic syringe needle in numerous medical processes and even in nature as the sucking tool of many insects, e.g. the “proboscis” of mosquitoes. In these different situations the ease at which the cutting or the puncturing tool incises the solid depends upon the geometry of the tool, its motion during cutting, incision or puncture and the coupled effect of these factors. We have examined these effects in the context of puncturing a soft hydrogel by a hypodermic syringe needle. Our experiments show that the needle does not puncture the gel continuously but intermittently with fracture progressing via alternate appearance of two different cracks: one ahead of the tool and the other radially away from it. In this talk I will discuss how asymmetry in geometry of the puncturing tool and its vibration can be employed for tuning the appearance of these cracks thereby minimizing the resistance to fracture. We will further extend these ideas in understanding the effect of geometry on adhesion and debonding of two different materials. Particularly, we will discuss about making soft surfaces decorated with hierarchical roughness patterns suitable for using as reusable adhesives and rewritable pads.

About C.N.R Rao Lecture Series

This lecture series was made possible by a generous donation by Prof. C.N.R. Rao, Linus Pauling Professor at JNCASR, Bangalore. The objective is to give one faculty member of the IIT Kanpur, each year, the honor of delivering a lecture to the institute's community, sharing the excitement of his/her research with them. Prof. Rao was a Professor of Chemistry at IIT Kanpur from 1963-76. During this period, he also served as the Dean of Research and Development. Prof. Rao also served as the chairman of BoG at IIT Kanpur from 2003 to 2006.

Prof. Rao was born on June 30, 1934, in Bangalore. In 1958, he completed his Ph.D. from Purdue University and became a research chemist at the University of California at Berkeley. During 1984-89, he served as the Director of IISc Bangalore. He was the founder president of Jawaharlal Nehru Center for Advanced Scientific Research (JNCASR), Bangalore. He received Bharat Ratna, the highest civilian award in India in the year 2014. He is the recipient of most of the major scientific awards and is a member of all major scientific organizations. He is a foreign member of the US National Academy of Sciences, American Academy of Arts and Sciences and also a Fellow of the Royal Society (London).

About the Speaker

Dr. Animangsu Ghatak joined IIT Kanpur in 2004 and is currently a Professor in the Department of Chemical Engineering. He obtained his B.Tech. from IIT Kharagpur (1994), M.Tech. from IIT Kanpur (1998) and Ph D from Lehigh University (2003). He carried out post-doctoral research at Cambridge University, UK and Harvard University, USA. He is an experimentalist who has research interests in diverse areas of mechanics of soft materials, e.g. adhesion, friction and fracture at soft interfaces, bio-inspired design of reusable surfaces, crystallization of macromolecules on nano-patterned surfaces, design of soft optical lenses and flow through microfluidic channels. Dr. Ghatak has been awarded with several awards namely Humboldt Research Fellowship for experienced researchers in 2011, DOST Professor S. K. Sharma Medal and Chemcon Distinguished Speaker Award in 2015 and in 2019 he has been elected as Fellow of INAE.

Past five speakers of the C N R Rao Lecture Series

Year	*Name*	*Title*
2018	Sandeep Verma	Bioinspired Systems for Disease Modeling and Cellular Delivery of Therapeutics
2017	Dipak Mazumdar	Steelmaking: Engineering, Challenges And Opportunities
2016	Debashish Chowdhury	Molecular Motors: Force and Fluctuations, Information and Infidelity
2015	Anindya Chatterjee	Simple models for frictional hysteresis
2014	R P Chhabra	To yield or not to yield: Convection in Visco-plastic Fluids

Contact: Dean of Research & Development