Modeling of Bonded Materials: Fundamentals and Applications

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5:00 pm
Room 116, Kaven Hall

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BIO: Denvid obtained his Bachelor degree with first class honors and Master degree in Civil Engineering from the University of Hong Kong (HKU) in 2004 and 2006 respectively, and got his second Master degree from the Department of Civil and Environmental Engineering (CEE) at Massachusetts Institute of Technology (MIT) in 2009. He then received his Ph.D. in the field of structures and materials from MIT in 2012. Prior to joining the City University of Hong Kong as an assistant professor in August 2012, he worked as a postdoctoral associate at MIT. Denvid got various awards and scholarships during his undergraduate and graduate studies including the Croucher Foundation Scholarship (2006-2009) and the Marvin E. Goody Award (2007). He was named as one of the Harvey Fellows in 2011. His research focuses on the multiscale modeling of organic-inorganic system, moisture-induced debonding, durability of concrete-epoxy system and fiber-reinforced polymer (FRP) composites in structural rehabilitation. To date, Denvid has attracted over HK$3 million fund in total for research and teaching development. He has published more than 40 referred journal and conference articles and has delivered more than 10 invited talks around the world.

ABSTRACT: Bonded material systems are found in various engineering applications ranging from nanoscale components, such as thin films in circuit boards, to macroscale structures, such as adhesive bonding in aerospace and civil infrastructure. They are also found in many natural and biological materials such as nacre or bone. The long term structural integrity of a bonded material system is mainly controlled by the interface. Prior research studies in this area have indicated that moisture-induced debonding is a complex phenomenon that may often involve a distinctive dry-to-wet debonding mode shift from the bulk material decohesion to the interface separation. Such premature failures may occur regardless of the durability of the individual constituent materials forming the material systems and further explanation at a more fundamental length scale is necessary. In this seminar, the molecular dynamics (MD) simulation technique will be discussed in the context of structural mechanics applications, providing a fundamental understanding of the atomistic approach, and demonstrating its applicability to a larger system using an appropriate multiscale model. The epoxy-silica system, which can be found readily in buildings and bridges, is used as an example. The prediction from the multiscale model shows a good agreement with the experimental data of the interfacial fracture toughness and the associated morphology of material captured under the scanned electronic microscope (SEM). The method used here provides a new approach to link nano to macro for complex material systems.