Shrinkage Stress in Dental Composite Restorations

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The physicist Wolfgang Pauli once commented, ‘God created matter, surfaces were the work of the Devil.’ For the dentist and their patients, God created resin composite restorations, but the Devil makes them debond through the creation of polymerization shrinkage stress.

Shrinkage or debonding of composite restorations can lead to post-operative sensitivity, microleakage, marginal staining and above all, recurrent caries. The study of polymerization shrinkage, shrinkage stress and bond strength of resin composites therefore forms an essential part of the design of such restorative systems.

In this talk, recent developments on the measurement of shrinkage stress and strain and their effect on the interfacial integrity of composite restorations will be discussed. It will be shown that, through the use of state-of-the-art equipment such as micro-CT and acoustic emission, it is now possible to not only see but also hear the work of the Devil.

Bio Dr. Fok obtained his BEng and PhD, both in Mechanical Engineering, from the University of Manchester, UK. He also has a BA in Mathematics from the UK Open University and an MSc in Mathematical Modeling and Numerical Analysis from the University of Oxford. Prior to moving to Minnesota, he was Senior Lecturer in Mechanical Engineering at the University of Manchester.

In 2007, Dr. Fok accepted the invitation of the University of Minnesota School of Dentistry to become Director of the Minnesota Dental Research Center for Biomaterials and Biomechanics (MDRCBB). Established as an industry-academic collaboration with funding from the 3M Foundation and 3M Dental Products Division, the MDRCBB works closely with the industry on the development of new dental products and biomaterials. Dr. Fok’s current research activities include shape optimization of dental restorations, shrinkage strain measurement using digital image correlation, nondestructive examination of interfacial debonding using acoustic emission and development of alternative bond test for dental materials. Together with colleagues from the Dental School, he has recently been awarded an NIH grant looking at the possible effect of bacterial activities on the degradation of composite restorations.