Viscosity related fatigue mechanism of bio-multilayers

Yue Ding[1,2], Gangfeng Wang[2], and *Xinrui Niu[1]

[1]Department of Mechanical and Biomedical Engineering, City University of Hong Kong, Kowloon, Hong Kong.
[2]Department of Engineering Mechanics, Xi'an Jiaotong University, Xi'an, Shaanxi, China

*Corresponding author: Xinrui.niu@cityu.edu.hk

Bio-structures often have multiple layers which include a hard top layer, a soft substrate layer and a joint layer in between. Soft substrate could introduce viscous deformation when bio-structure endures fatigue loading. The viscous effect on fatigue behavior is of great importance to understand biological structures and to develop biomimetic structures.

This presentation investigated viscosity related fatigue mechanism of a bio-multilayer structure adopted in dentistry. Viscosity of the soft substrate was measured with various experimental methods, fitted into viscoelastic models and incorporated into both analytical model and computational simulation. Fatigue behavior of the multilayer structure is then predicted by taking substrate viscosity into account. A map of fatigue life vs. frequency was constructed by both experimental measurements and computational simulation. The study could not only assist in-depth understanding on fatigue behavior of biological structures but also provide guidance to the design of durable biomimetic structures.

Keywords: Viscosity, Fatigue, Multilayer, Bio-structures