Experiment and Modeling on MFC Stress Induced Function Degradation

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1. Introduction

Macro fiber piezoelectric composite (MFC) actuator and sensor have good application prospects in structural vibration suppression, health monitoring and energy harvesting. Due to the stress coupling of MFC and main structure, piezoelectric properties degradation caused by the stress depolarization effect is unavoidable. Consequently, actuating and sensing function degradation of MFC is inevitable. This will jeopardize the function reliability of piezoelectric structure system, such as piezoelectric vibration control system, piezoelectric energy harvesting system, piezoelectric health monitoring system.

2. Experiment and result of MFC function degradation after static stress loading

In order to study the degradation process of the actuating function of MFC actuator undergoing cyclic loading, actuation function degradation test of MFC has been carried out with MFC beam specimens, and the actuating function of MFC were tested. Test set up for MFC function degradation test is shown in fig. 1.

Fig. 1 Test set up for MFC actuation function degradation test

Experimental results show that under action of cyclic stress the function degradation process of MFC presents nonlinear characteristics. Stress induced MFC actuation function degradation test data is shown in fig.2.

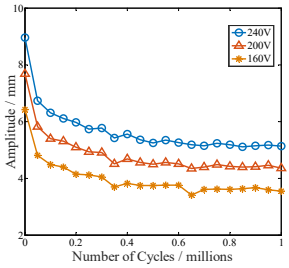

Fig. 2 Stress induced MFC actuation function degradation test results

Using the measured MFC function degradation data, Radial Basis Function (RBF) neural network learning method was adopted to establish the prediction model of MFC function degradation induced by stress. The obtained prediction model can be used to predict the degradation degree of MFC function induced by cyclic stress loads, which can be seen in fig.3.

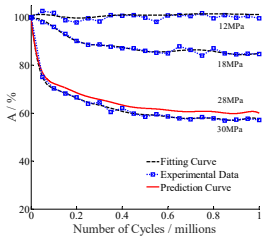

Fig. 3 MFC function degradation prediction result obtained by RBF neural network model

Acknowledgment

This work was supported by the National Natural Science Foundation of China [Grant No. 11502208].

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