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Abstract
In this dissertation, we analyze the vibration and sensitivity of lateral, axial, and torsional vibration of a scanning near-field optical microscope probe. Many exact solutions for the title problems are obtained by using the theory of beam and torsional vibrations. The Laplace transform and exponential function are used to derive the sensitivity equations. The numerical examples are also presented. The results of sensitivity for the scanning near-field optical microscopy probe are summarized in the following.
1.The free vibration of the scanning near-field optical microscopy probe:
(1) When the non-dimensional lateral spring constant increases, then the different natural frequencies at mid-location of the lateral spring become increasing. (2)The first natural frequency gets larger as the non-dimensional lateral spring constant becomes larger. (3)The first natural frequency increases when the probe length decreases. (4)The axial natural frequencies of the first to fifth mode become larger when the non-dimensional axial spring constant is more than the value about 0.09.
2.On the sensitivity of interactive damping of the scanning near-field optical microscope probe:
(1)Each mode has a different level of sensitivity and the optical fiber probe is the most acceptive to higher levels of flexural vibration in the first mode. (2)The probe is generally more sensitive when spring constant is lower. (3)The flexural sensitivities of the first five modes are similar when the lateral damping is taken into account. (4)The damping effect is proportional to the value of lateral spring constant. (5) The axial sensitivities of the first five-modes are analogously when the axial damping is taken into account.
3.Sensitivity investigation of the different direction vibrations of the scanning near-field optical microscope probe:
(1)When the lateral sensitivity is undamped for a beam with the lateral spring constant increased, then the sensitivity of the first mode is decreased, the second mode has a maximum sensitivity, the sensitivity of the third mode is decreased, and the sensitivities of the fourth and fifth modes are a little greater. (2)When the lateral sensitivity is damped for a beam with the lateral damped increased, then each mode is more sensitive, the first mode is the most sensitive mode of lateral vibration for an SNOM cantilever. (3)When the axial sensitivity is damped for a rod with the axial damped increased, then the first mode shows more sensitivity than the other modes. The sensitivity of the first mode is more increased. The sensitivity of the second to fifth modes is a little more decreased when the axial damped is greater. (4)When the torsional sensitivity is undamped for a rod with the lateral spring constant increased, then the sensitivity of the second mode is slightly increased, the third mode has a

maximum sensitivity, the sensitivity of the third mode is decreased, the sensitivity of the first and fourth modes is slightly increased, and the sensitivity of the fifth mode is unchanged. (5) When the torsional sensitivity is damped for a rod with the lateral damped increased, then the first mode has more sensitivity, the sensitivity of the first mode is increased, and the sensitivity of the second to fifth modes is slightly decreased.
These results of sensitivities and vibration analysis can be applied to study the relative academic research and design a new type micro-probe system in the feature.
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