Experimental Studies on the Dynamic Responses of Coated Superconductor Stack Levitated above a Permanent Magnet Guideway

ID: ***Mon-Af-Po1.05-04***

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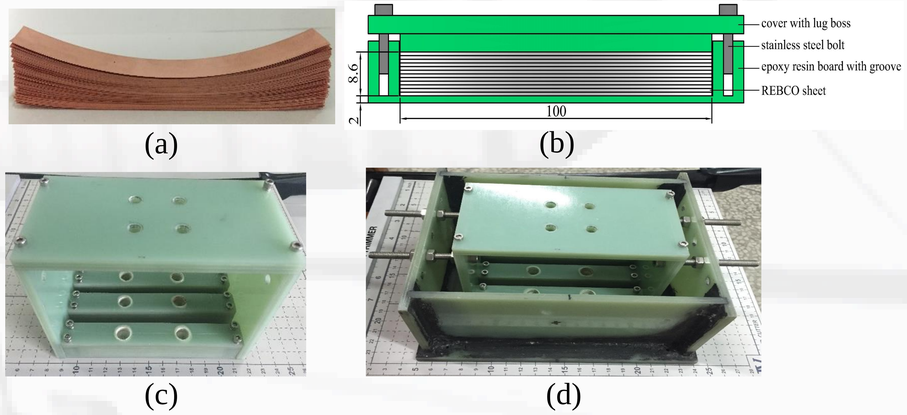
Introduction

The quasi-static levitation characteristics of coated superconductor stack have been investigated for the purpose of constructing a stack-based superconducting maglev. However, the research on dynamic performance of the stack against external disturbances is rarely reported. Due to its strong influence on running performance of stack-based superconducting maglev, this work experimentally investigated the dynamic characteristics of coated superconductor stack levitated above a permanent magnetic guideway.

Experimental details

Test sample



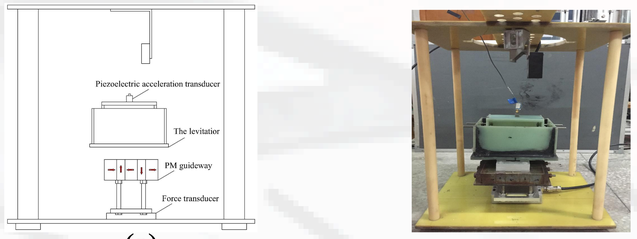
(a) (b) (c) (d)

Figure 1 (a) 120 REBCO tapes, (b) Cross section of one stack (c) The assembled module with three stacks, (d) Module with LN_2 container

Test cases

1. Unloading condition, reflecting vibration caused by reducing the load.
2. Free fall condition, representing levitation gap changing in running.
3. Pulsed excitation, to measure natural frequency of levitation system.

Vibration platform



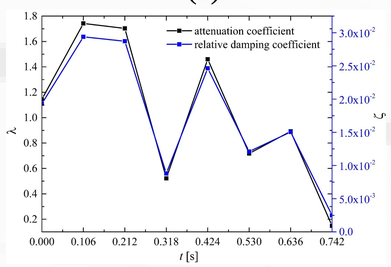
(a) (b)

Figure 2 (a) Sketch of test rig, (b) photo of test rig.

Results

Unloading condition

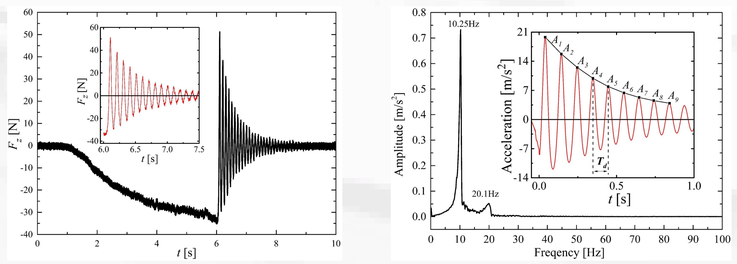
(a) (b)



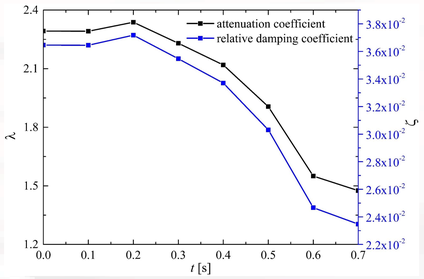
(c)

Figure 3 (a) loading process and force variation, (b) vertical acceleration and its spectral analysis by Fast Fourier Transform (FFT), (c) damping performance.

Free fall condition



(a) (b)



(c)

Figure 4 (a) loading curve and force variation, (b) vertical acceleration and its spectral analysis by FFT, (c)damping performance

Pulsed excitation

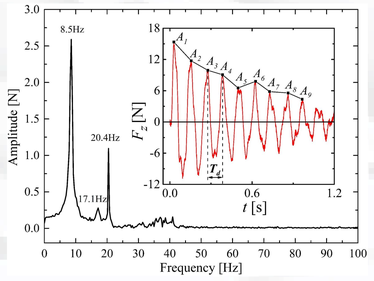


Figure 5 force variation and its spectral analysis by FFT, a strange frequency of 20.4Hz is obvious which reflects structural vibration of passive levitator.

Conclusion

1. The levitation system can be equivalent to be a constant stiffness but variable damping system under unloading and free fall conditions, besides, it is a low damping system.
2. Pulsed excitation will cause structure vibration of passive levitator which will influence on exploring natural frequency of the levitation system.

Acknowledgement

This work was supported in part by the National Natural Science Foundation of China under Grants 51475389, 51722706 and 51707164, in part by the Sichuan Youth Science&Technology Foundation under Grant 2016JQ0003.