Electronic Supplementary Material (ESI) for RSC Advances

Supporting information for:

Structure formation process, heat-insulation property and cyclic compression-resilience performance of mullite fibers/whiskers frameworks

Shan Liu, Jiachen Liu, Haiyan Du, Feng Hou*, Sue Ren, Haitao Geng

Key Laboratory of Advanced Ceramics and Machining Technology of Ministry of Education, School of Materials Science and Engineering of Tianjin University, Tianjin 300072, China

E-mail: houf@tju.edu.cn

Phone: +86 022 27402102

Supporting information for characterizing the mullite whiskers which were peeled off from the MF/MW frameworks.

It should be noticed that the MF/MW frameworks were grinded into powders for TEM preparation. During the grinding process, some whiskers were peeled off from the fibers, and some of them were destroyed into fragments. Therefore, isolated whiskers or whiskers' fragments could be observed in the TEM images.

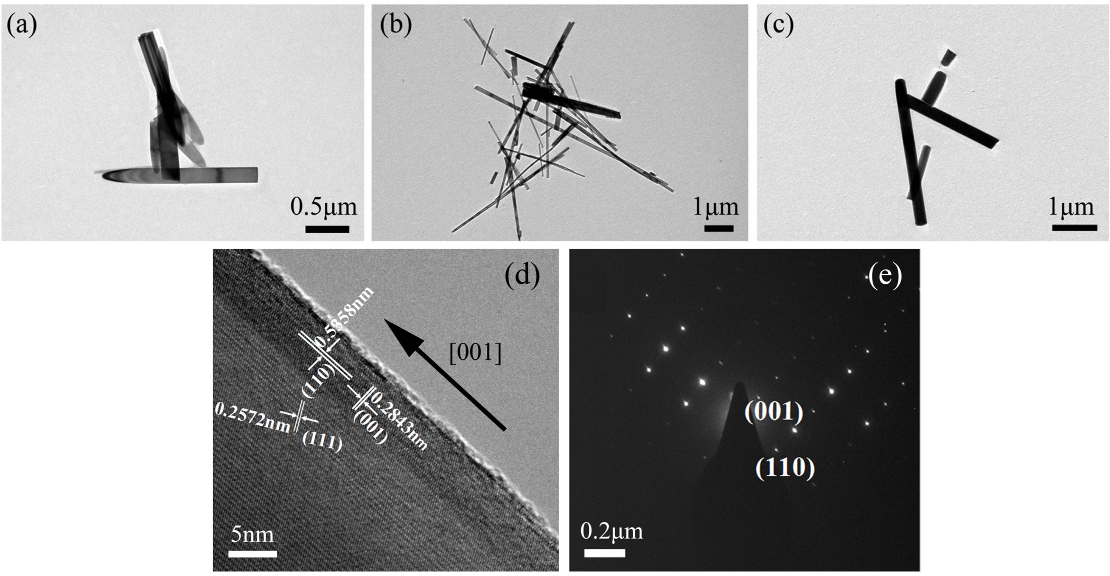

Figure S1. TEM images of the mullite whiskers which was peeled off from the mullite fibers of MF/MW frameworks formed at 1100°C (a), 1400°C (b) and 1500°C (c); (d) and (e) were high magnification view and SAED pattern of the mullite whisker that were showed in Figure S1(b).

Supporting information for the cyclic compression-resilience performance of the MF/MW frameworks.

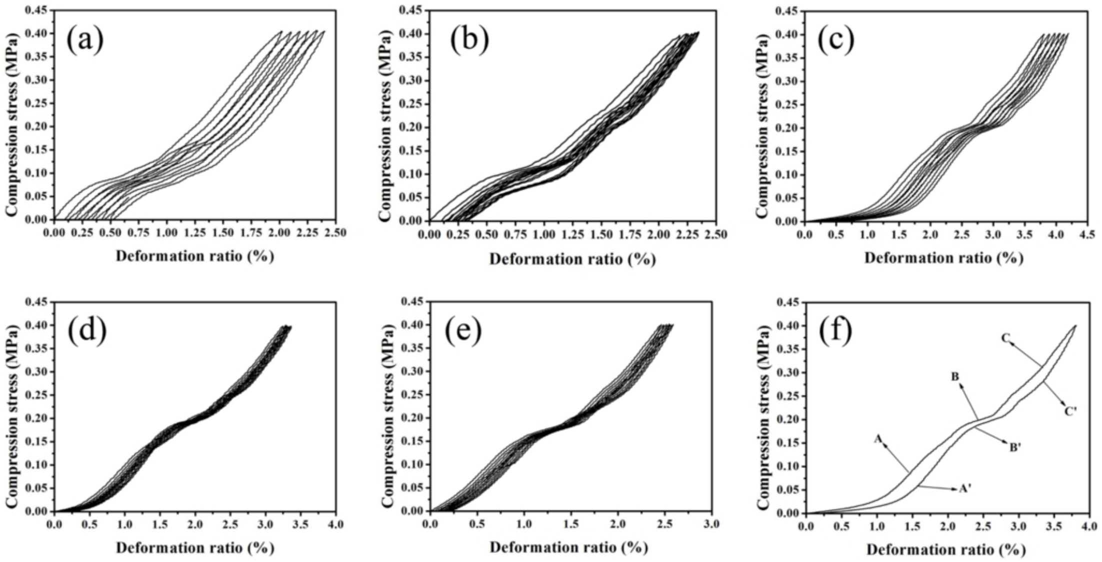

Figure S2. Cyclic compression-resilience performance of the MF/MW frameworks that formed at 1100°C (a), 1200°C (b), 1300°C (c), 1400°C (d) and 1500°C (e), (f) was a example of the typical one circle compression-resilience curve of the MF/MW framework.

One circle compression-resilience curve of the MF/MW framework {in which the mass ratio [(mullite fibers)/(mixed AlF_3-SiO_2 powders)] was 1/0.5} had six stages which had been reported in our former work [1]. The stages were marked in Figure S2(f) as an example. Stage A indicated the deeper intersection of the mullite whiskers at the lap-jointing points. When the compression stress was loaded gradually, the intersected mullite whiskers as lap-jointing points of the fibers tended to intersect in a deeper mode, and this caused a part of temporary deformation. Stage B was the sliding process of the mullite whiskers at the lap-jointing points. As the compression stress keeping on increasing, the mullite whiskers stopped their deeper intersection and began to slide along the fibers to buffer the outer stress. This process also caused a part of temporary deformation in the MF/MW framework. Stage C was the bending/stretching/compacting process of the mullite fibers. When the compression stress rose to a certain level, the mullite whiskers' sliding process stopped. The flexile mullite fibers began to bend/stretch/compact for buffering the outer stress. This process caused another part of temporary deformation of the MF/MW framework. Stage C' indicated the recovering process of the mullite fibers. After the compression process, the compression stress was unloaded gradually, and the mullite fibers tended to recover to their initial state. Stage B' was the reversed sliding process of the mullite whiskers. In this process, the mullite whiskers slid along the fibers in an opposite direction and tended to move to the initial position. Stage A' was an recovery process of the mullite whiskers' deeper intersection. The intersected mullite whiskers overcame the inside friction and recovered to the initial intersecting situation. The compression-resilience process could be realized by the co-action of flexile mullite fibers and intersected mullite whiskers. The permanent deformation remained in the MF/MW frameworks after the compression-resilience test was on account of the structure damage of the mullite whiskers that occurred in the test process.

Reference

[1] S. Liu, J. C. Liu, H. Y. Du, F. Hou, S. E. Ren, H. T. Geng, Hierarchical mullite structures and their heat-insulation and compression-resilience properties, Ceramics International (2013), http://dx.doi.org/10.1016/j.ceramint.2013.10.154