

“Mica/SGF-armored skeleton” in PDMS foam composites for improving fire-proofing performance

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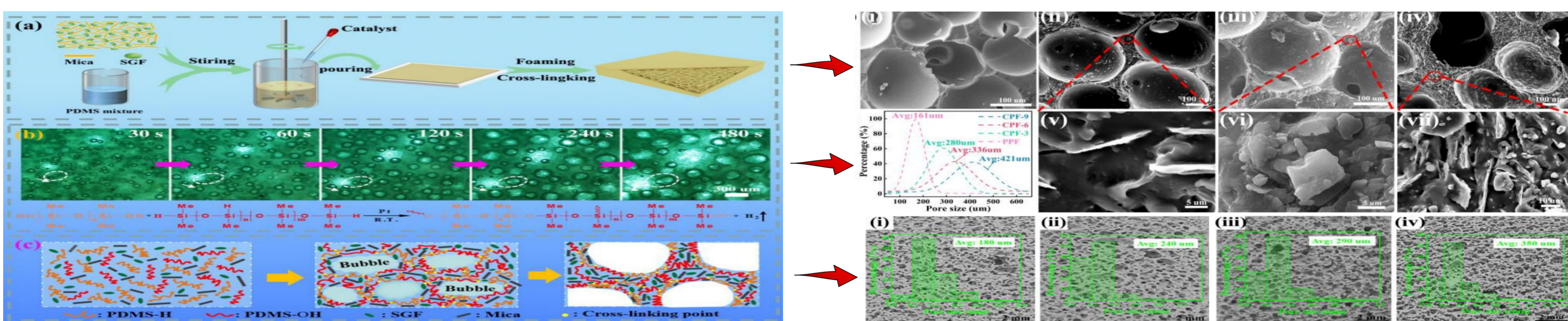
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Abstract

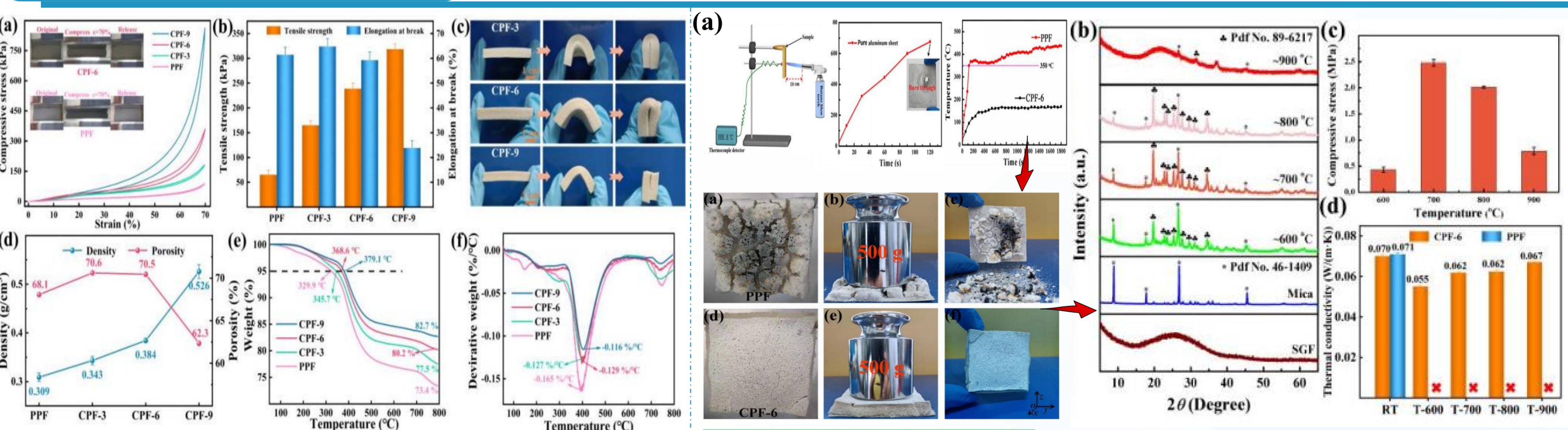
The fire-proofing property of polydimethylsiloxane (PDMS) foam at constant high-temperature firing conditions is limited, restricting its further applications. In this work, mica/silicate glass frit (SGF)-armored skeleton was constructed in PDMS composite foam via a “one-pot” process. The construction of mica/SGF-armored skeleton not only endows the PDMS composite foam with outstanding structural and thermal stability at high temperatures or even in naked fire, but also significantly improves its mechanical properties and flame retardancy. The results showed that the prepared PDMS composite foam can resist above 1000 °C flame for 30 min without disintegration and keep the thermal conductivity of the sample before and after ablation at a very low level around 0.07 W/(m·K). Compared with pure PDMS foam material, the minimum oxygen concentration necessary to support the combustion of PDMS foam composite with mica/SGF-armored skeleton increased by 24.3%, and the tensile strength and compressive strength at strain of 25% of the optimized foam sample were increased by 364.9% and 322.3%, respectively. This work provided a promising and facile method to prepare PDMS composite foam simultaneously possessing excellent fire-proofing performance and mechanical properties.

Experimental



- PDMS composite foam with excellent fire-proofing performance was developed through constructing “Mica/SGF-armored skeleton”.
- The mica/SGF-armored skeleton structure transform to ceramic skeleton in the conditions of high temperatures or combustion.

Results and discussion

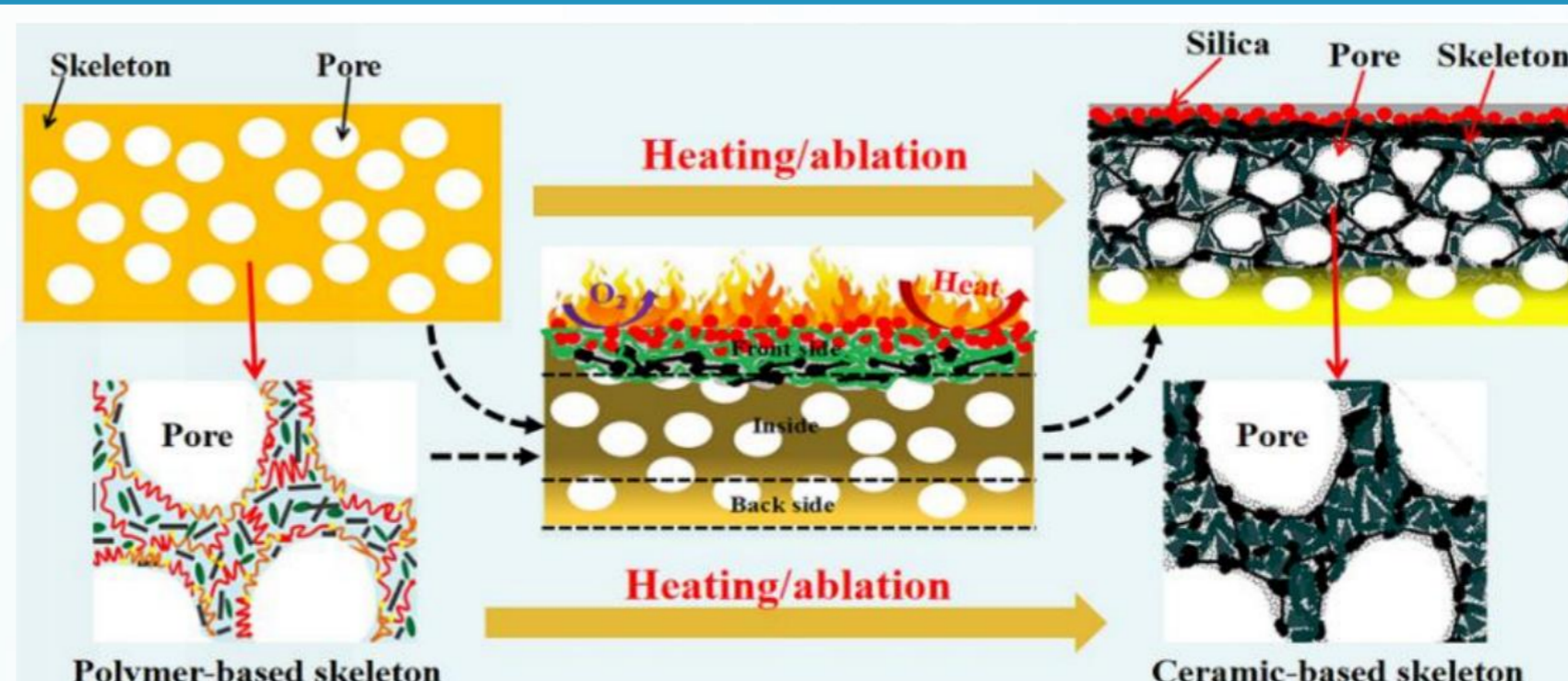


- Mica/SGF-armored skeleton endows PDMS composite excellent mechanical and thermal properties.

- Mica/SGF-armored skeleton endows PDMS composite excellent fire resistance and thermal insulation performance as well as flame retardancy.

Fire-proofing mechanism

- Nano-silica moieties cover the surface to form a silica barrier layer, preventing the exchange between the materials and external substances.
- SGF in the skeleton melts to form a liquid phase which acts as liquid bridge between mica and silica, producing a complete ceramic network that blocks the flame and heat spread.



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