Monitoring the fiber separation from the matrix with high-speed infrared thermal imaging

Stéphane Boubanga-Tombet, Alexandrine Huot, Frédérick Marcotte

Telops, 100-2600 Saint-Jean Baptiste Ave, Québec (QC), Canada

stephane.boubanga@telops.com

Infrared thermal imaging also often called thermography, is a very evolving field in science as well as industry owning to the enormous progress made in the last three decades in microsystem technologies of infrared detector design, electronics, and computer science. The development of high speed infrared cameras with high temporal resolution has given rise to a wide variety of demanding thermal imaging applications ranging from academics and research, industrial R&D, non-destructive testing and materials testing, aerospace and defense. We have recently demonstrated the potentialities of high-speed (Telops FAST-M2K) and high-definition (Telops HD-IR) infrared imaging in experimental mechanics by monitoring heat releases during tensile and shear tests were carried out on steel, aluminum and carbon fiber composite materials [1].

In the present work we extended this experimental mechanics studies on aramid fiber in an epoxy matrix using our recently developed FAST M3K camera. The aramid fiber is a category of the synthetic fibers having high thermal properties. Those fibers are high strength materials that exhibits good resistance to abrasion; good resistance to organic solvents; no melting point; no degradation until 500°C; low flammability; sensitivity to acids, salts and ultraviolet radiation. These peculiar properties have increased the interest of the aramid fiber in the aerospace industry for the manufacture of the body parts; in the military for making ballistic accessories; in body armor for making of boat hulls; in automobile and in the making of heat resistant helmets clothing etc. The implementation and optimization of the above-mentioned application will require a detailed understanding of the different properties of the aramid fiber. In particular, the wear and friction behavior of the fiber when embedded for instance in epoxy matrix. Thanks to the high performances of the FAST M3K camera with frame rate of more than 14 000 frames per second, we successfully monitored separation of the fiber from the matrix during high-strain split Hopkinson bar test, providing important additional insights into the characterization of fiber/matrix materials in experimental mechanics.

References

[1] Gagnon MA., Marcotte F., Lagueux P., Morton V. (2018) High-Speed Infrared Imaging for Material Characterization in Experimental Mechanic Experiments. In: Baldi A., Considine J., Quinn S., Balandraud X. (eds) Residual Stress, Thermomechanics & Infrared Imaging, Hybrid Techniques and Inverse Problems, Volume 8. Conference Proceedings of the Society for Experimental Mechanics Series. Springer, Cham