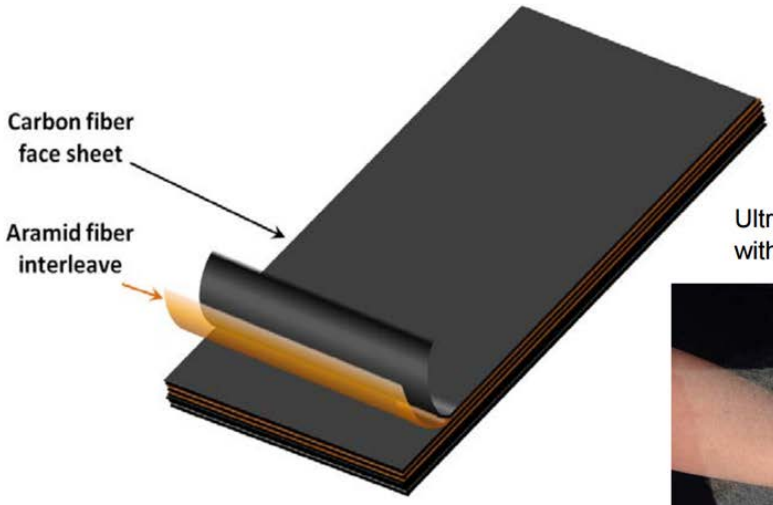
THE UNIVERSITY OF WESTERN AUSTRALIA

Research Development & Innovation

Interfacial toughening of composites with ultra-thin Kevlar® layer

UWA technology licensing/ partnering opportunity

- **Improved strength of adhesive joints & interfaces**
- **Improved impact resistance**
- **Resistant to delamination**
- **Machining-damage resistant carbon-fibre composites**
- **Minimal impact on material thickness & weight**



Ultra-thin tissue of aramid fibres with free fibre ends (3g/m^2, 4mm)

The Problem

The weakest link of adhesive joints, or between layers of composite materials is typically a thin layer of e.g. epoxy resin.

The Solution

Adding an ultra-thin layer of aramid fibres to this thin resin layer in question can significantly improve the performance of the joint / composite component. Protruding free fibre ends of the short Kevlar fibres connect/bridge the interface and thus improve adhesion. Such layers could easily be incorporated into prepreg materials.

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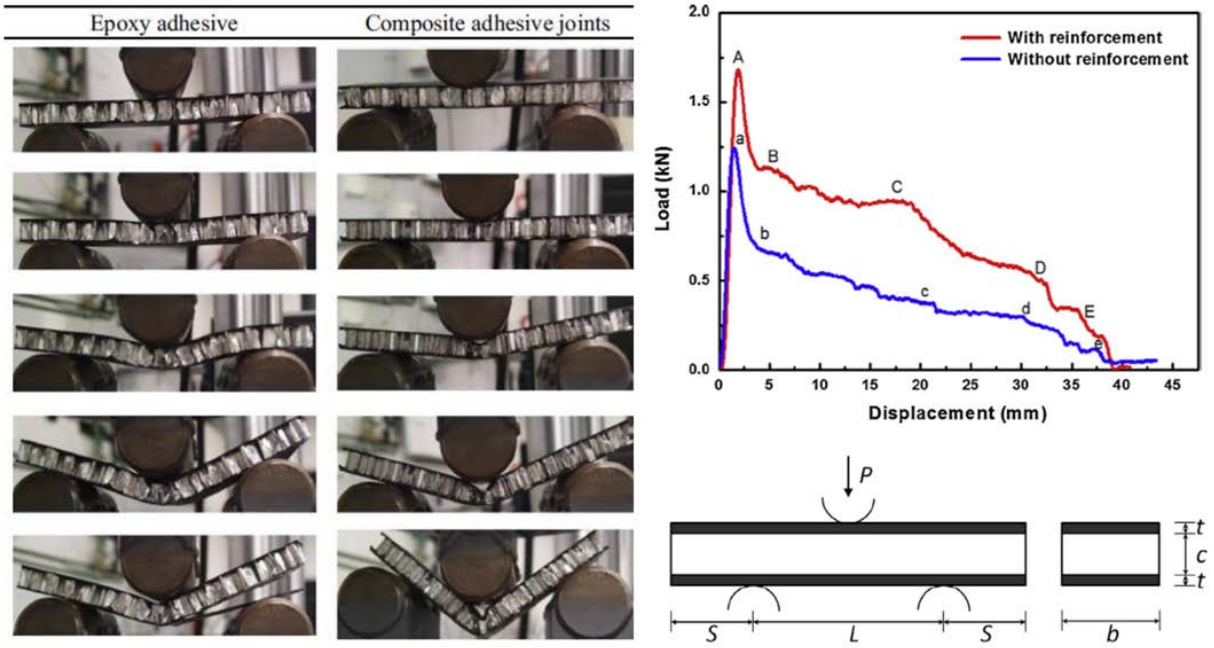
Background

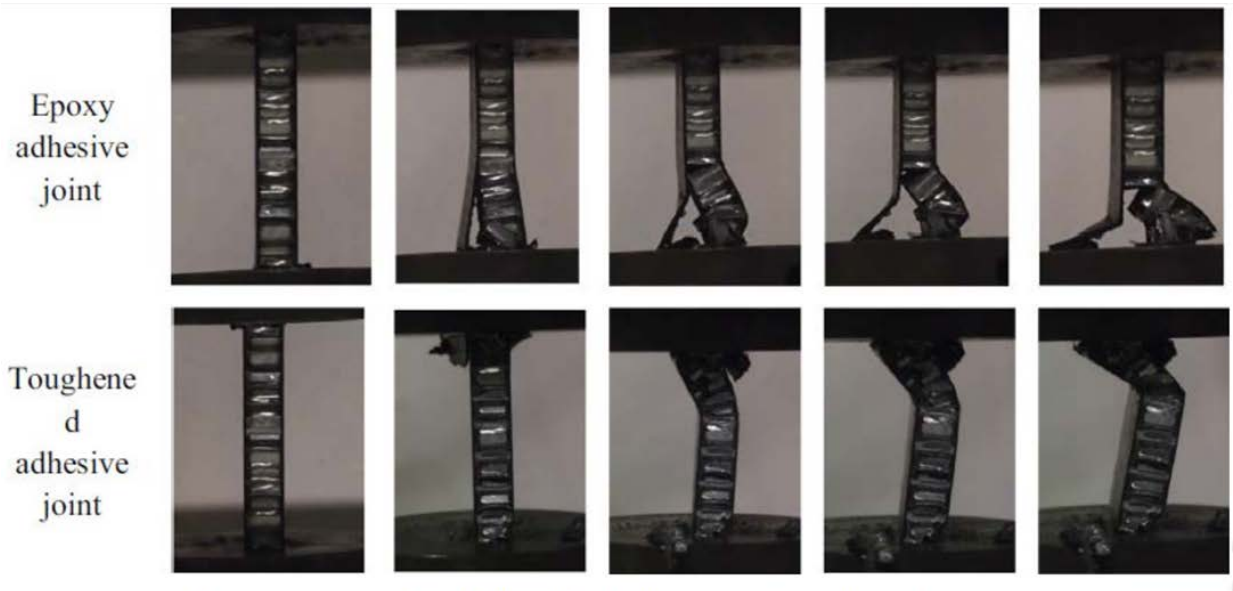
Research at The University of Western Australia (UWA) on composite materials and adhesive bonding has led to insights that increase the toughness of interfaces between layers of composite materials as well as the interface at joints between composite and other materials. Research Development & Innovation Ultra-thin tissue of aramid fibres with free fibre ends (3g/m2 , 4mm) 2

Adding of aramid (Kevlar®) fibres to toughen composite interfaces is not new, but has to date resulted in significant weight and component thickness penalties. UWA researchers have developed a process to manufacture ultra-thin layers of aramid fibre (e.g. 3 grams/m2) and thus enable the toughening of composite interfaces with minimal impact on component weight and thickness.

Example 1: Carbon Fibre Al-honeycomb Sandwich

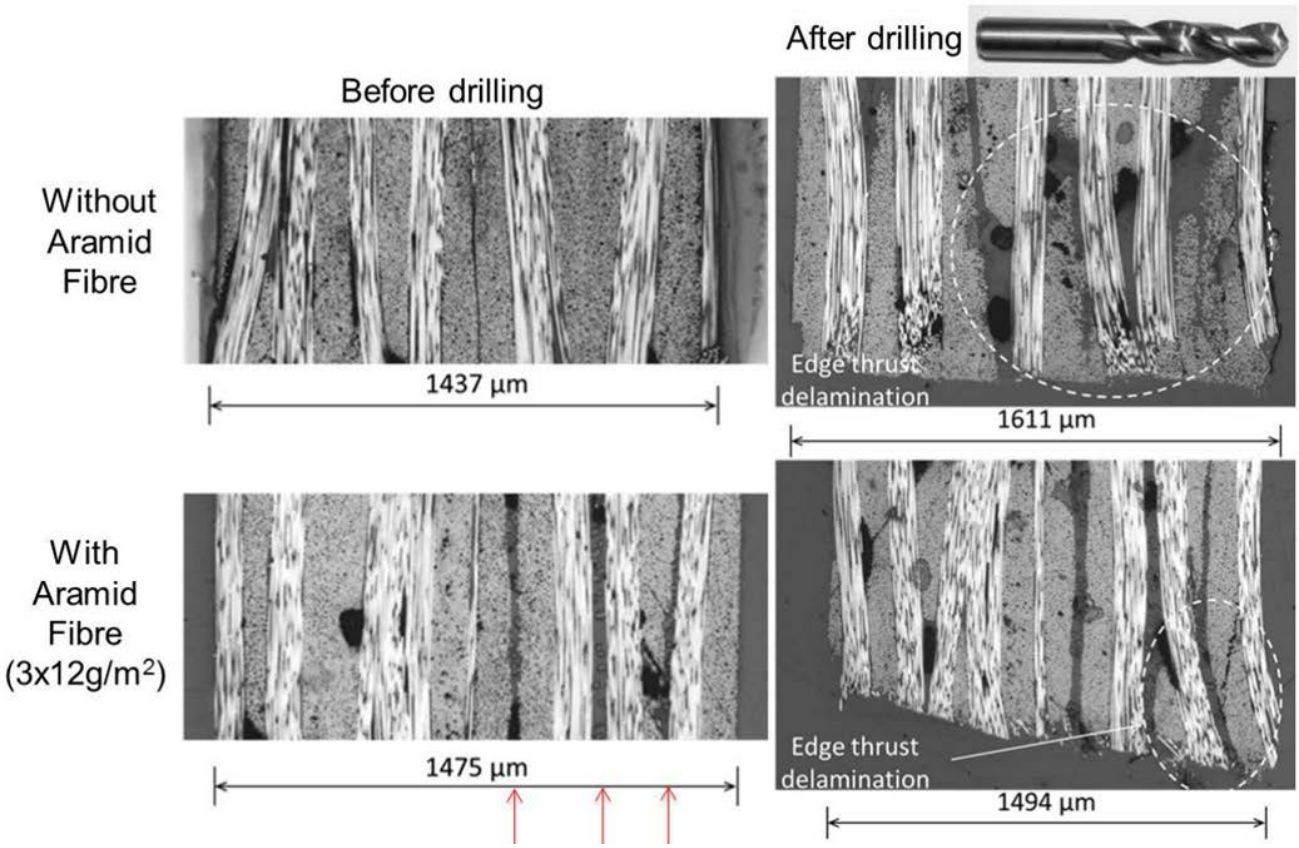


3-Point Bending test with “Epoxy adhesive”, and “Composite adhesive joint” (interfacial aramid layers of 12g/m2) – demonstrating increased strength as well as resistance to delamination

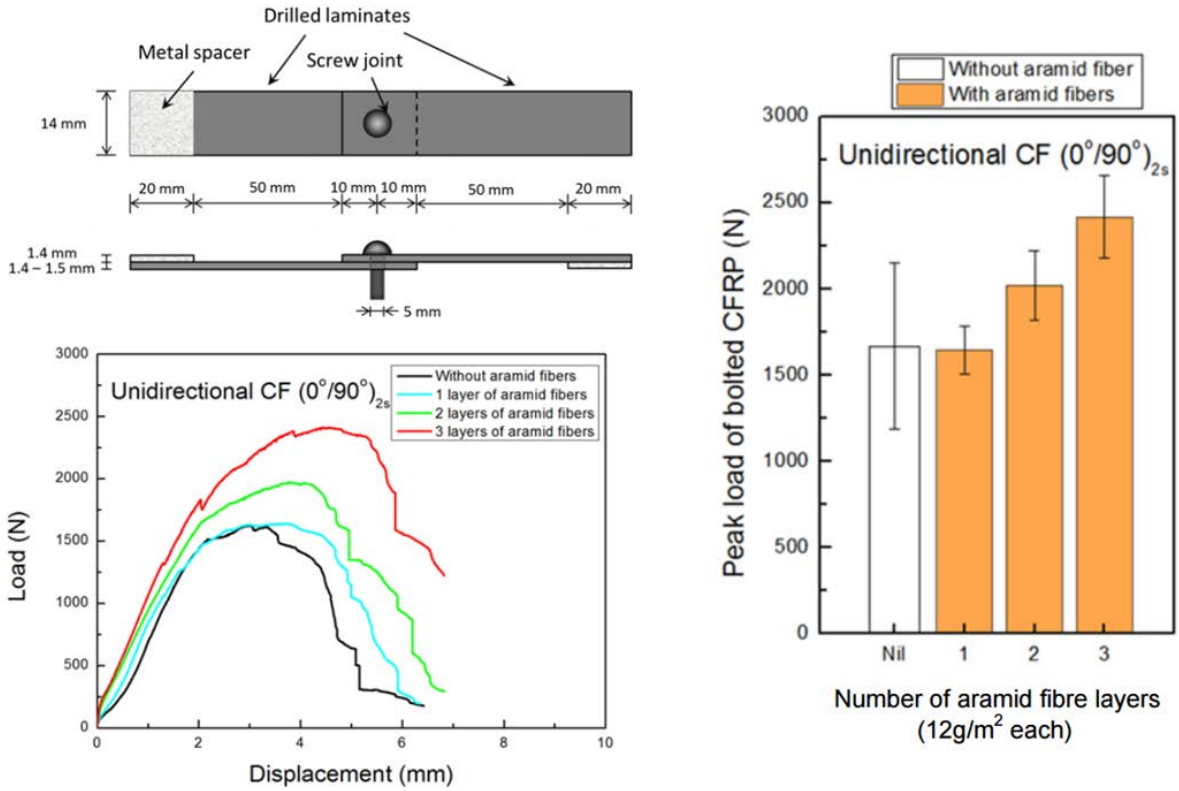


A compression test further illustrates the improved performance.

Example 2: Machining-damage resistant CF composites



Drilling damage to the standard component adds 174µm thickness; Adding 3 layers of Aramid fibre increases thickness by 38µm, but drilling only adds another 19 µm.



A Tensile test of the drilled components reveals significantly improved performance with the addition of aramid fibre layers.

Commercial Opportunity

A Tensile test of the drilled components reveals significantly improved performance with the addition of aramid fibre layers. Number of aramid fibre layers (12g/m2 each) 4 Commercial Opportunity We are keen to create impact through adoption of the interfacial toughening technology by industry, and are looking for partners with suitable applications. Opportunities to collaborate with an industry partner on both the interfacial toughening and other composite material technologies will be particularly appreciated.

The University of Western Australia

UWA is a research-intensive university ranked 96th in the world (Shanghai Jiao Tong University's internationally recognised Academic Ranking of World Universities – August 2016), and one of the internationally recognised Australian Group of Eight Universities.

References

Xiaozhi Hu et al, "Edge Delamination and Residual Properties of Drilled Carbon Fiber Composites with and without Short-Aramid-Fiber Interleaf", Applied Composite Materials, 19th May 2016.

Xiaozhi Hu et al, "Short-aramid-fiber toughening of epoxy adhesive joint between carbon fiber composites and metal substrates with different surface morphology", Composites:Part B, vol 77, 08/2015.

Xiaozhi Hu et al, "Carbon-fiber and aluminum-honeycomb sandwich composites with and without Kevlar-fiber interfacial toughening", Composites:Part A, vol 67, 12/2014.

Further Information

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