Design, Friction Stir Processing and characterization of a new healable aluminium alloy

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Aluminium alloys are widely used as structural materials in transportation and aerospace. Despite the excellent combination of lightweight and strength, several properties of Al alloys, such as strength and damage tolerance, should be further enhanced to remain competitive on the market. One way of improving the strength of Al alloys is to combine them with reinforcements, thereby developing aluminium matrix composites (AMCs). AMCs present several advantages compared to classical Al alloys, such as higher strength and elevated temperature resistance. Furthermore, to improve damage tolerance of Al alloys and AMCs, friction stir processing (FSP) can be used. However, the classical approach of damage prevention is not the only solution to improve damage tolerance and meet materials sustainability requirements. Alternatively, damage management approaches like self-healing strategies can be employed to expand the lifetime of alloys. In the present study, a new healable Al alloy/composite presenting healing behaviour was produced by FSP. A new Programmed Damage and Repair healing concept was proposed. In this concept, damage appears preferentially on sacrificial particles during loading. As the selected healing heat treatment is applied, healing occurs using the matrix atoms as healing source. Healing was demonstrated by perfoming in-situ experiments using X-Ray synchrotron nano-tomography and TEM.