**Time-resolved Diffraction Studies of the Combustion Synthesis of NiAl/TiC Composite**

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Combustion synthesis is a cheap and easy technique to fabricate a large range of materials, including ceramics and composites. It is possible to synthesize a compound by exploiting the exothermic properties of the chemical reaction. Two combustion modes exist depending on whether the synthesis occurs in the form of a wave traveling through the sample (Self-propagating High-Temperature Synthesis SHS) or if it occurs simultaneously in the whole sample (Explosive mode). Despite a lot of advantages, combustion synthesis is barely used in industry due to a lack of understanding of the synthesis mechanisms.

In this work, in-situ time-resolved diffraction using synchrotron radiation has been applied to determine the crystallographic changes occurring during the SHS in air of a mixture of Al, Ni, Ti and C. Time-resolved diffraction is the only in-situ technique able to provide information about the synthesis mechanisms without influencing the propagation of the combustion front. The experiments were performed in transmission using a small X-ray beam of 200x200 □m (E=45keV). During the reaction, 2D diffraction patterns were acquired with a frequency of one pattern every 135 ms (25 ms of acquisition time and 110 ms of readout time). The results show a complex sequence of reactions including the formation of several intermediate phases, which then lead to the formation of a simple biphasic product of small round particles of TiC embedded in a large grained NiAl matrix. A possible synthesis mechanism has been proposed to explain the formation of this composite. In order to determine if both combustion modes lead to the same synthesis mechanisms, recent results on the same reaction studied in explosion mode using time-resolved neutron diffraction will be presented and compared with the time-resolved X-ray diffraction results.

**Keywords: time-resolved diffraction, combustion synthesis, NiAl/TiC composite**