Joining with reactive nano-multilayers

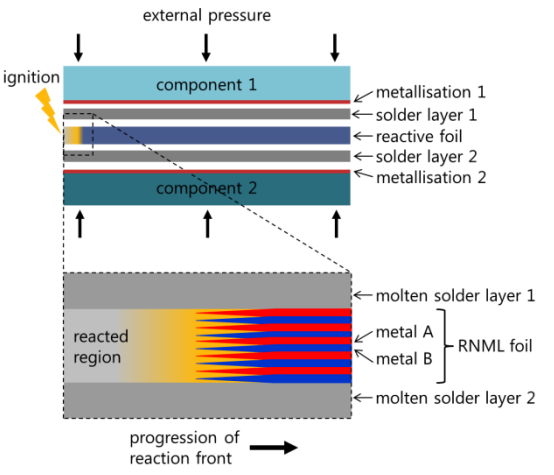
Empa Department 202, Joining Technologies and Corrosion

Empa
Materials Science and Technology

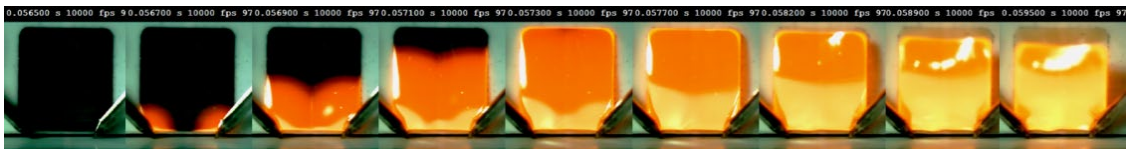
Principle

Reactive nano-multilayers (RNMLs) are composed of alternating nano-scaled layers of two components which can undergo a strongly exothermal reaction, i.e. a considerable amount of heat is produced by the reaction. RNMLs can therefore be utilised as a local heat source, e.g. for soldering, which, for instance, allows joining of temperature-sensitive components.

For joining, the RNML foil is inserted between two solder layers (or fusible surfaces in general). The exothermal reaction is initiated with an electric spark or with a laser. Due to the high speed of the reaction, bonding is achieved within seconds (→ Video-Link).



Schematic setup for reactive joining; the nano-layers can also be directly sputter-deposited onto the component surface.



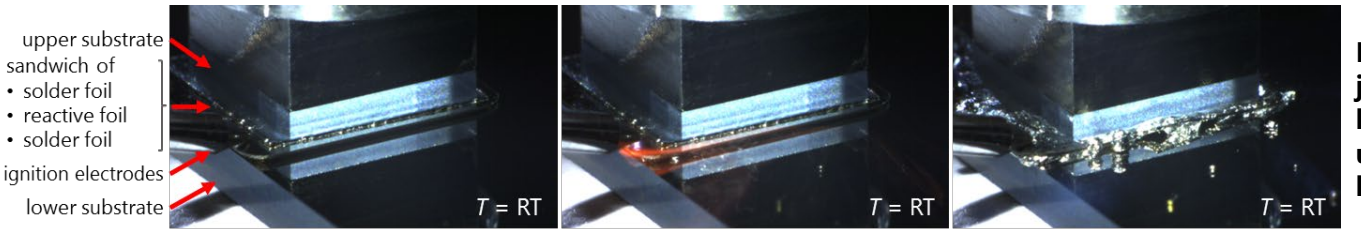
Reaction sequence of an RNML foil recorded with a high-speed camera. The reaction was initiated with an electric spark using two electrodes.

Advantages

- localised heat source: components remain "cold"
- no furnace, no protective atmosphere, no flux required
- easy handling of joining components (→pick & place)
- short processing times
- generally high joint strength
- good thermal properties (heat conductivity)
- stability against high temperatures & humidity

Typical applications

- joining of temperature-sensitive components
- joining of stress-sensitive components
- hermetic encapsulations, controlled atmosphere
- prototyping
- alternative to step-soldering
- rework
- …



Example: reactive joining of borosilicate glass using a flip chip bonder

Our expertise

- development of novel reactive joining systems and dedicated solutions for benign reactive joining

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