

# POLYURETHANE ADHESIVES WITH ENHANCED ADHESION AND MECHANICAL PROPERTIES DUE TO THE ADDITION OF VERY SMALL AMOUNTS OF GRAPHENIC CARBON MATERIALS

**P** PATENTED TECHNOLOGY

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## ABSTRACT

Polyurethane adhesives are widely used in industry for bonding materials in the footwear, electronics, renewable energy, aeronautics, and construction industries, as well as in composite materials. However, they have limitations due to their mechanical properties and stiffness.

Researchers at the university have developed a process to add different graphenic carbon materials to polyurethane adhesives in a very small amount (less than 0.1% by weight). In this way an adhesive with improved thermal and mechanical properties (mainly toughness), and notably increased adhesion properties have been obtained.

The resulting adhesives have been tested for verifying their new properties. These properties are ideal for use in high performance applications, such as in the electronic components industry.

## TECHNOLOGY ADVANTAGES AND INNOVATIVE ASPECTS

- Significant improvement in the adhesion properties of the polyurethane adhesives.
- The resulting adhesive has excellent thermal, mechanical and conductivity properties, as well as improved toughness.
- Minimum amount of graphenic carbon material (less than 0.1% by weight) is needed. In the state of the art there are some examples of the addition of graphenic carbon materials to adhesives but in no case in such a low proportion.
- The addition of graphite oxide (GO), milled graphite (MG) or graphite or grapheme nanoplatelets (GNP) does not require the use of ultrasounds to disperse into the polyurethane adhesives.
- Non-functionalised graphenic carbon materials are used. Until now, most of the previous studies in polyurethanes require the functionalization of the graphenic carbon material.
- The viscosity and color of the polyurethane adhesive are not altered by the addition of graphenic carbon material (less than 0.1% by weight).

In industry there is a need to use polyurethane adhesives with improved adhesion properties that also impart toughness to the adhesive joints made with them.

Until now, the use of graphenic carbon material as an additive to polyurethane adhesives had not been studied in depth and their influence on their adhesion properties was unknown. The work developed by the researchers has allowed the development of a process to obtain different polyurethane adhesives with significant improvements in their adhesion and mechanical properties with the addition of a minimum quantity (less than 0.1% by weight) of graphenic carbon material. These improvements are related to the excellent dispersion of the graphenic carbon nanoparticles in the polyurethane matrix (Figure 1).

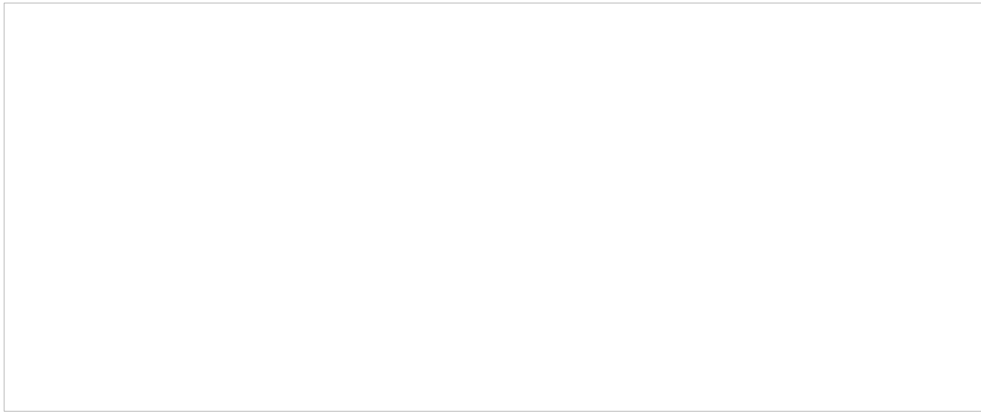


Figure 1. SEM micrographs of polyurethanes with different amounts of GO.

Improved adhesion (T-peel tests) of waterborne polyurethane adhesives containing different amounts of graphite oxide(GO)is shown as an example in Figure2.

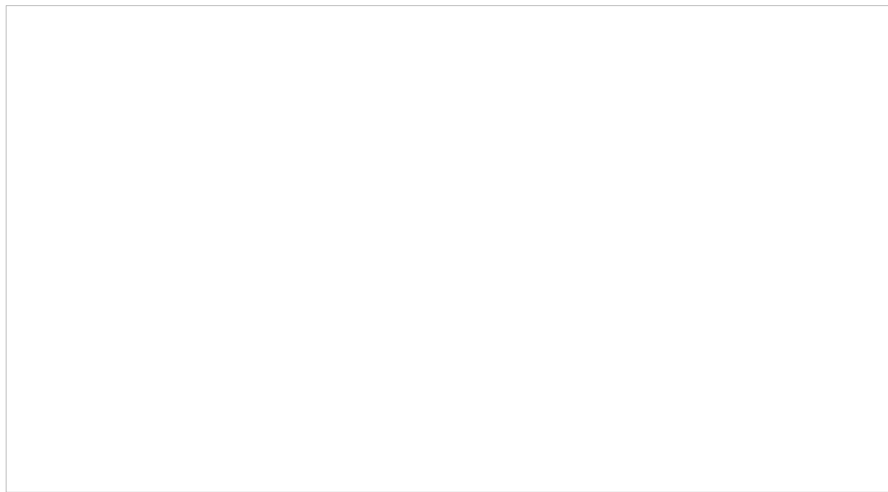


Figure 2. Variation of the T-peel strength of plasticized PVC/waterborne polyurethane dispersion-GO/plasticized PVC as a function of the amount of graphene oxide (GO) in the adhesive

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#### MARKET APPLICATIONS

This type of adhesives has a wide variety of application fields. It can be used in the joining of different materials where adhesion requirements are high and also requires high performance in terms of thermal, mechanical (particularly toughness) and electrical properties.

Among its fields of application are their use in the manufacture of electronic components, energy storage devices, gas purification systems, etc.

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#### COLLABORATION SOUGHT

Researchers are looking for partners to negotiate patent licensing agreements, as well as to develop R&D projects that allow the development of specific adhesives adapted to the specific needs of companies.

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