Offre de POSTE Chercheur Docteur
ISAE-SUPAERO / ICA CNRS UMR 5312
Période 12 mois reconductibles

Start from November 2018

Title	Influence of the strength of the adhesive layer on the performance of a ceramic-adhesive-composite system
Supervisors to be contacted	**Christine ESPINOSA, Frédéric LACHAUD, Éric PAROISSIEN** **Institut Supérieur de l'Aéronautique et de l'Espace (ISAE) – SUPAERO** Département de Mécanique des Structures et des Matériaux 10 Avenue Edouard Belin | 31055 TOULOUSE | FRANCE christine.espinosa@isae-supaero.fr , frederic.Lachaud@isae-supaero.fr , eric.paroissien@isae-supaero.fr
Lab	**Institut Clément Ader (ICA UMR 5312)** 3 Rue Caroline Aigle 31400 TOULOUSE www.institut-clement-ader.org

Context and Stakes

These works are related to a PhD Thesis (2016-2019) performed in collaboration with the following laboratories ICube, ICA and ISL.

The PhD Thesis deals with the performance of shielding made of a ceramic layer and a backing composite layer. The main function of the ceramic layer is to slow down the advance of the impacting projectile. The main function of the composite backing layer is to retain the ceramic fragments. An adhesive layer is used to join the ceramic and composite layers.

If it is of highest relevance to understand the fragmentation modes of the impacting layers (Michel et al. 2006), it is required to take into account for the influence of the strength of the adhesive layer on failure modes. Indeed, the deflection of the backing adhesive layer is restricted – preventing from dramatic perforation – while the adhesive layer offers a sufficient stiffness.

The objectives of works are to better understand the structural effects of the three-layers system and of the adhesive layers under various strain rates. These works will be led at two scales to reach two different objectives.

1. **experimental investigations** : in order to characterize the behavior of the three-layers system and of the adhesive layer
2. **experimental and numerical modeling** : to suggest a methodology for simplified and/or refined simulations.

Description

Objective 1 : experimental investigations

The mechanical behavior of the three-layers system and of the adhesive layer will be investigated under various loading conditions: quasi-static, Charpy, Hopkinson and other dynamic tests (Colard 2015) (Francart 2017).

Objective 2 : experimental and numerical modeling

The simplified modelling could be based on the macro-element technique (Paroissien et al. 2018) and/or the use of cohesive zone modeling. The main difficulty in this part is the development

of algorithms allowing for the integration of the mechanical behavior as functions of strain rates. If a implicit computation scheme is already available, one objective is the addition of an explicit computation scheme, possibly coupled with the implicit one.

The goal is to provided methods and tools for the prediction of the strength of the multilayered adhesively bonded system.

Location

The works will mainly be performed at ICA in Toulouse, France (F-31). Some experimental tests will be performed at Icube (Strasbourg, France, F-67) and ISL (Saint-Louis, France, F-68).

References

(Colard 2015) L. Colard, Etude du comportement sous impact balistique d'un blindage multicouche à composantes carbure de bore et aluminium, thèse de doctorat, Université de Lorraine, 2015.

(Francart 2017) C. Francart, Experimental and numerical study of the mechanical behavior of metal/polymer multilayer composite for ballistic protection, thèse de doctorat, Université de Strasbourg, 2017.

(Michel et al. 2006) Y. Michel, J.-M. Chevalier, C. Durin, C. Espinosa, F. Malaise and J.-J. Barrau. Meshless modelling of dynamic behaviour of glasses under intense shock loadings: application to matter ejection during high velocity impacts on thin brittle targets.. Proceedings of 8th International Conference on Mechanical and Physical Behaviour of Materials under Dynamic Loading 2006

(Paroissien et al. 2018) E. Paroissien, L.F.M. da Silva, F. Lachaud, Simplified stress analysis of functionally graded single-lap joints subjected to combined thermal and mechanical loads, Composite Structures, Vol. 203, pp. 85-100.

Profile and skills of applicants

The applicant will have a PhD Thesis or have an experience in research activities and an engineer or MSc diploma. The main following skills are expected:

- to have basics on the mechanical behavior of polymeric materials
- to tailor the Finite Element Method
- to be autonomous in the development of MATLAB codes
- to be experienced in experimental testing under quasi-static and transient dynamic
- to be experienced numerical testing under quasi-static and transient dynamic

Conditions and salary

Fixed-term contract for duration of 36 months. Salary according to ISAE-SUPAERO scale.

The justified applications shall be sent to Christine Espinosa, Frédéric Lachaud and Éric Paroissien.

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