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Institut de Recherche Dupuy de Lôme

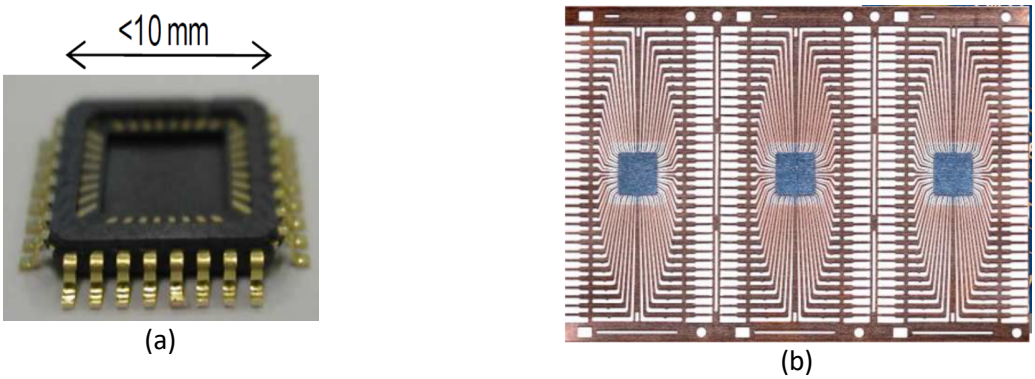
Virtual forming of electronic components made of copper alloys

Post-doctorate position at IRDL

Head of the project: Pr Sandrine THUILLIER

Starting date: last trimester of 2018
Duration: 18 to 24 months
Raw salary: 2800 € per month
How to candidate: email a CV and motivation letter, as well as a reference letter form the PhD supervisor to S. Thuillier**sandrine.thuillier@univ-ubs.fr**

The general framework of this study concerns the virtual design of electronic components. Such components, as resistors or semiconductors, have connectors (or leads) to ensure the passage of the electric current. Such isolated device or integrated circuit is assembled by soldering on metallic frames or leadframes, that assure the heat dissipation and electrical connections with the environment. Examples of leads and leadframes are shown in Fig. 1. Moreover, a resin packaging of the device and leadframe is performed, for electrical insulation and protection from the environment. This packaging step creates an evolution of the residual stresses obtained after the forming steps and the adhesion of the resin to the metal guarantees the performance of the component



(a) (b)

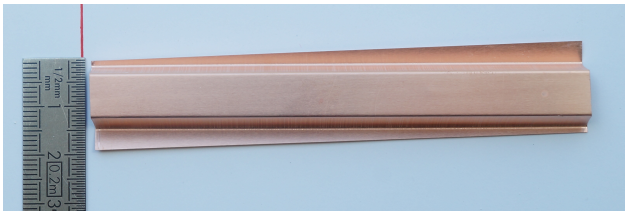
Figure 1 : (a) leads for an electronic box [1] and (b) leadframe [2]

The choice of materials for leads and leadframes results from a compromise between electrical and thermal conductivities and mechanical properties. Pure copper (99.9%) and copper alloys with zinc, tin, iron, beryllium, under sheet form, are good candidates. The sheet thickness depends on the application and lies in the range from 0.1 mm up to 1-2 mm. The electronic components are then obtained after several steps with progressive tools, steps of drawing, bending and blanking. The numerical prediction of

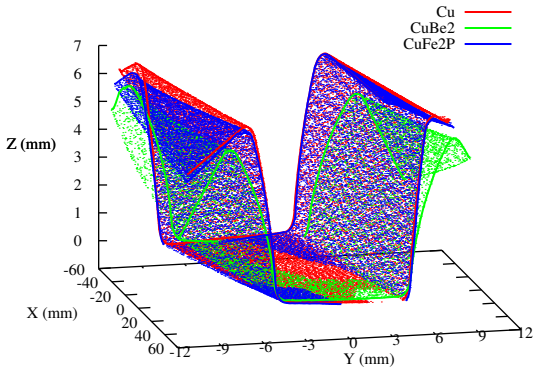
the final shape is essential to guarantee the quality and the durability of the connections between the components, that are either smoldered or clipped on the leadframe.

The aim of the post-doc is the virtual design by finite element simulation of parts in copper alloys, considering the different steps of drawing, bending , springback and blanking. A mixed experimental-numerical approach is chosen, to develop and validate the virtual design. The aim of the numerical approach is to design the part in a reliable way the process, with an eco-friendly way that minimizes scrap. The scientific challenges concern the numerical prediction of residual stresses at each step, with an accurate model of the mechanical behavior of the materials. Preliminary experimental results were obtained on 2D and 3D springback (twisting) of a U-shaped part, with an original rig developed at IRDL. These results show a strong influence of the material on the final shape, cf. Fig. 2 [3,4]. A first step of this study is to perform the numerical simulation of this process (choice of constitutive equations, identification of material parameters, numerical model) to have a better understanding of the reason of this dependence. In a second step, other geometries will be dealt with, aa part of the collaborative project EXPRESSo (http://irdl.fr/index.php/2018/02/15/projet-collaboratif-expresso/).

Diffusion of the results is very important, with the writing down of articles in scientific journals and the presentation at international conferences.



(a)



(b)

Figure 2 : (a) U-shaped part after forming and springback and (b) influence of the material on the final shape [3]

Background of the candidate: mechanics of materials, numerical simulation with Abaqus, constitutive equations, forming process, experimental mechanics.

References

[1] F. Adzima (2016) Modélisation et simulation de procédés de mise en forme de tôles métalliques ultrafines Thèse de l'Ecole Nationale Supérieure d'Arts et Métiers (in French)
[2] S. Meunier (2005) Analyse expérimentale du découpage progressif de précision à grande vitesse d'un alliage cuivreux en faible épaisseur, thèse de l'Université de Franche-Comté (in French)
[3] S. Thuillier, C.H. Pham, P.Y. Manach, 2D springback and twisting after drawing of copper alloy sheets Numisheet 2018, Tokyo (Japan), 30 July-3 August. IOP Conf. Series: Journal of Physics: 1063 (2018) 012124 doi:10.1088/1742-6596/1063/1/012124
[4] C.H. Pham, S. Thuillier, P.Y. Manach, Twisting analysis of ultra-thin metallic sheets, Journal of Materials Processing Technology 214 (2014) 844-855 10.1016/j.jmatprotec.2013.12.006