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## Comparing Selective Corrosion of Au-based amorphous, partially amorphous, and devitrified alloys

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### Abstract

Corrosion studies in an acidic environment have been performed for the good  $\text{Au}_{40}\text{Cu}_{28}\text{Pd}_5\text{Ag}_7\text{Si}_{20}$  glass former with emphasis on the selective dissolution (de-alloying) process. The final porous microstructures obtained from fully amorphous ribbons and ribbons containing crystals as well as composition inhomogeneity in their amorphous matrix. The results are compared by using the same etching conditions. As reference, ribbons containing different crystalline fractions produced by isothermal annealing at temperatures in the glass transition region and then de-alloyed. The results show that a different mechanism of de-alloying operates for amorphous and crystallized materials. The finer homogenous nanoporous structure occurs after de-alloying a fully crystallized ribbon.

### 1. Introduction

Au-based amorphous alloys are possible precursors for developing homogeneous nanoporous gold structures (NPG) composed of ligaments and pores [1-9] through the process of selective corrosion (de-alloying) resulting in materials with high surface area. The NPGs have been tested as electro-catalysts [2,3] and substrates for SERS activity [4,5] showing good activity. One of the main features of NPG derived from glassy alloys is that the ligament networks deriving from Au-based amorphous alloys have a different morphology in comparison to those derived from Au-based crystalline alloys [6], because of the spontaneous germination of many crystals during de-alloying giving ligaments made of several fine crystalline domains rather than a single crystal.

The  $\text{Au}_{40}\text{Cu}_{28}\text{Pd}_5\text{Ag}_7\text{Si}_{20}$  composition is reported as one of the best glass formers among Au-based alloys [10] and was chosen for the studies of this work. Its composition conforms to the requirements for de-alloying, i. e. the difference in the standard redox potentials among the alloy components, [11-13] and the parting limit corresponding to the maximum content of Au needed to avoid surface passivation. The  $\text{Au}_{40}\text{Cu}_{28}\text{Pd}_5\text{Ag}_7\text{Si}_{20}$  can be de-alloyed by using the alloy as anode in an electrochemical cell in 1M  $\text{HNO}_3$  at 70°C [2,3].

During the processing of glass formers by rapid solidification, minority crystalline phases, often metastable, can nucleate from the melt and remain embedded in the amorphous

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