Volume shrinkage during dealloying of silver-gold alloys

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Dealloying or selective dissolution route to prepare nanoporous metals and alloys has attracted considerable interest due to possible application e.g. sensors, actuator and corrosion studies [1,2]. Dealloying method offers to prepare nanoporous samples with controlled structure size and flexibility to form nanoporous samples of different shape and size.

Because of complete solubility in the whole composition range and very less lattice constant difference between Ag and Au, silver-gold alloys present a good model system to study the dealloying process. Micro-morphology study of dealloyed sample by SEM, TEM and XRD reveals the existence of a porous structure with crystal grain size larger than pore size (figure 1), which suggests the original crystal lattice of the alloy is conserved in dealloying process. *Insitu* strain measurements by dilatometer reveal lateral shrinkage of the sample during dealloying. The overall volume shrinkage, which depends on the dissolution rate (hence on dealloying potential) and the composition of the alloy, has not been reported before. The volume of the sample reduces by up to 30% during dealloying, although our measurements show conservation of crystal lattice during dealloying. This result cannot be explained with elastic lattice strain or with lattice parameter differences between the constituents of the alloy. Therefore, we suggest extending the existing model [3] by plastic deformation processes to explain the observation, which is consistent with the high defect concentration in dealloyed structure as observed by TEM. Several possible mechanisms to nucleate the defects during dealloying are discussed.

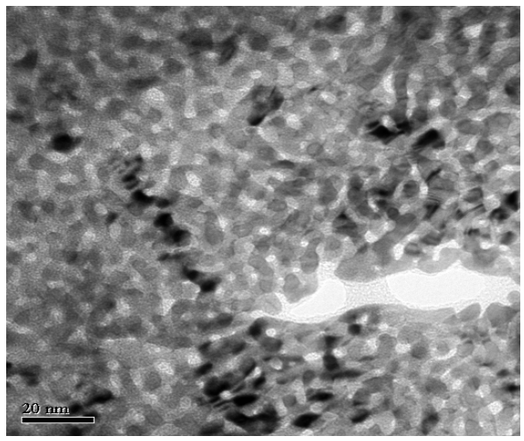

Figure 1: Bright-field transmission electron micrograph of dealloyed gold leaf (Wasner, 6 carat) showing the bicontinuous microstructure consisting of interpenetrating networks of pores and Au ligaments.

REFERENCES

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