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S. Pérez-Tamarit, E. Solórzano, A. Hilger, I. Manke, M.A. Rodríguez-Pérez

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Multi-scale tomographic analysis of polymeric foams: A detailed study of the cellular structure

S. Pérez-Tamarit[a,*], E. Solórzano[a], A. Hilger[b], I. Manke[b], M. A. Rodríguez-Pérez[a]

[a] *Cellular Materials Laboratory (CellMat), Condensed Matter Physics Department, Science Faculty, University of Valladolid, Paseo de Belén, 7, 47011 Valladolid, Spain.*

[b] *Helmholtz-Zentrum Berlin fürMaterialien und Energie, Lise-Meitner-Campus, Hahn-Meitner-Platz 1 14109, Berlin, Germany.*

* Corresponding author: saul.perez@fmc.uva.es

Abstract

This manuscript presents a detailed characterization of the cellular structure of two types of polymeric foams by non-destructive multi-scale X-ray computed micro-tomography. This comparative study is conducted in two different polymeric materials –rigid polyurethane foams and cross-linked low density polyethylene foams-. Based on this technique and using 3D image analysis, conventional descriptors of the foams gaseous phase (cell size distribution, mean cell size and anisotropy ratio) are characterized at a standard voxel size of 5 microns. Complementarily, 0.4 microns voxel size synchrotron X-ray tomography data sets have been used to characterize, using a new image analysis approach, features of the solid phase of the foams (fraction of mass in the struts and thickness of the different entities of the solid architecture: struts and walls). The presented methodology, based on multi-scale tomographic analysis, allows obtaining a better understanding of the connection between foaming process and cellular structure and is important to gain knowledge on the structure-properties relationships for these materials.

Keywords: X-ray tomography; Imaging; Polyurethane; Polyethylene; Polymeric foams characterization