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3D investigation of a PS/ABS polymer using different microscopy techniques



X. Jaurand¹, E. Errazuriz², S. Reynaud³, T. Douillard⁴, F. Dalmas⁴, S. Descartes⁵, F. Simonet⁶, M. Mondon⁷, I. Anselme-Bertrand⁸

RéCaMiA Network

Context of the study

ReCaMiA is a regional Microscopists Network (Région Rhone Auvergne and Alpes) of the CNRS. Technics available are : SEM & TEM, Near Field Microscopy, Confocal Microscopy... Interdisciplinary and sharing of experience : Materials Science, Chemistry, Biology...

- Inventory microscopy equipment's and competences in the region Take advantage of know-how diversity to develop mutual aid
- 0
- Participate to the practical training of previous and veen the network's members Facilitate contacts in microscopy community of the region Organize structuring actions : Workshops to share scientific and inological knowledge, joint work on new technologies... Participate to the practical training of new microscopists Technology and competences watch group

materials such as polymers is still challenging especially for organic-organic multiphase samples where no

polymer blend), we present here a comparative study on the different 3D characterization technics available through the French Récamia network (FIB/SEM, TEM, SEM).

The obtained volumes are quantitatively compared and the main advantages, artifacts and limitations of each technic. are discussed.

Multiscale control sample



→ Stiffening of the mat microtomy and FIB milling at room temperature

Mateis

LABORATOIRE

SANTE



Comparison and Discussion

	Electron tomography	FIB-SEM	Serial section SEM
Number of detected particles	89	12000	465
Volume fraction	30%	21%	20%
Degree of anisotropy ^a	NA	0.78	0.68
Particle volume distribution	$V_{mean} = 10^{5.5} \text{ nm}^3$	$V_{mean1} = 10^6 \text{ nm}^3$ $V_{mean2} = 10^8 \text{ nm}^3$	$V_{mean} = 10^7 \text{ nm}^3$

^aCalculated from the "mean intercept length" in the volume

Conclusion			
Technics	Advantages	Drawbacks	
Electron tomography	Acquisition is automatized Very good resolution in x, y and z, which allows to obtain good information's about morphology (size, shape, porosity)	Only a small portion of volume is reconstructed which is not representative of the whole sample Sample could be modified during acquisition Reconstruction artefacts due to missing wedge make image analysis difficult (problems for segmentation) Particles larger than the section thickness cannot be reconstructed entirely.	
FIB-SEM	Good contrast, and resolution Acquisition is automatized Large volume (x, y, z)	Sample could be modified during acquisition	
Serial section SEM	Good visualization of particles distribution at large scale Contrast, resolution (single image)	Cut (ribbon) presents difficulties, Heterogeneous sections, Acquisition is not automatized Poor resolution in z Px size in x ant y is too large compared to particles size. Small objects cannot be detected correctly Px size in z (= section thickness) is much too large: not possible to obtain a good representation of the real particles shapes → Sources of errors in image analysis	

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- int-Etienne, FRANCE ne, F-42270 Saint-Etie