Non-coherent video-reflectometry of growing pores in plasticized polymers during supercritical fluidic foaming

E. V. Ushakova[1], M.V. Alonova[1], D.A. Zimnyakov[1, 2]

[1] Yuri Gagarin State Technical University of Saratov, Politekhnicheskaya St. 77, 410054 Saratov, Russia

[2] Institute of Precision Mechanics and Control, Russian Academy of Sciences, Rabochaya St. 24, 410024 Saratov, Russia

ABSTRACT

A method of non-coherent video-reflectometry based on acquisition and analysis of image sequences in the back-reflection mode under white light illumination is examined for characterization of the nucleation stage in plasticized bioresorbable polymer (polylactide) foamed under pressure quenching in the “polylactide – supercritical/subcritical carbon dioxide” system. Features of image formation are discussed for the cases of the formation and growth of the surface and bulk pores in the plasticized polymer. Expansion of the video-reflectometric technique for the case of coherent illumination (the full-field speckle-correlometric technique) is considered.

The experimental data analysis technique is illustrated by Fig. 1. It can be seen from the figure that the observation of a bubble occurs from the beginning of its formation until the moment when the sizes of the remaining bubbles in the volume of the object are comparable. The zones of gas release in the polylactide (bubble) in homogeneous gas-saturated polymer are characterized by the projections of zone boundaries onto the image plane. In Fig. 1, they can be seen as circled areas. Finding the zone radii, we obtain the characteristic sizes of bubbles depending on the current pressure.

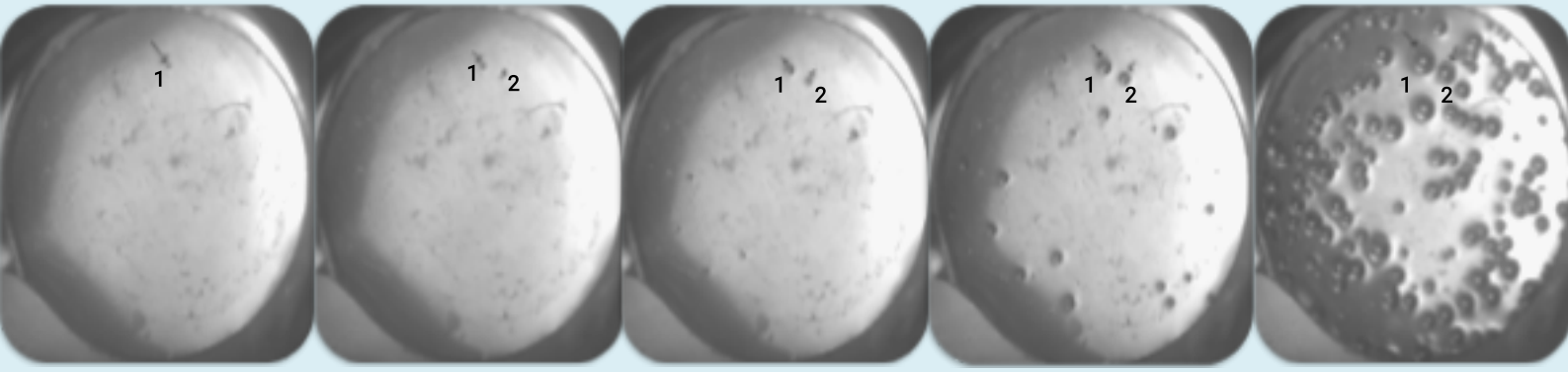

Fig., 1. An example of image sequence obtained using the video reflectometry technique.

On the base of the obtained datasets, we can recover the dependencies of bubble radius on the current pressure in the reactor (external pressure). Figure 2 displays the typical “pressure-radius” dependencies for pore germs appearing at two different values of the external pressure.

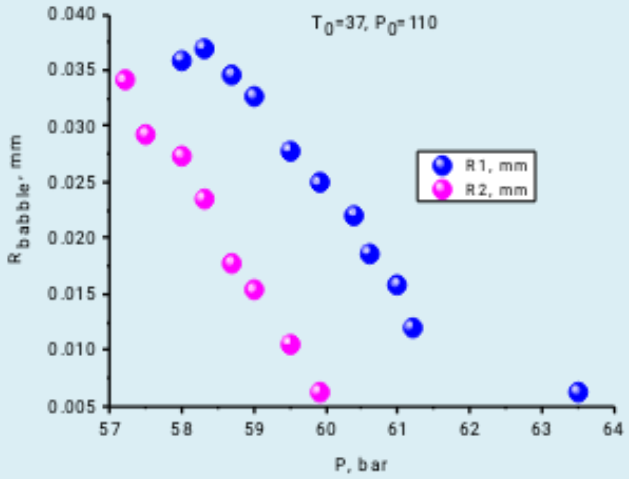

Fig. 2. The characteristic bubble radii versus the current pressure.

CONCLUTIONS

The analysis of evolving foamed structures using the video reflectometry technique is carried out. The effect of external pressure on nucleation and pore growth is considered. The data obtained refer to development of diagnostic methods for synthesized porous structures.

ACKNOWLEDGMENT This work was supported by the RFBR grant # 18-29-06024.