Relationship between the structure anisotropy of PFA polymer/ compressed expanded graphite – matrix composites and acoustic emission characteristics

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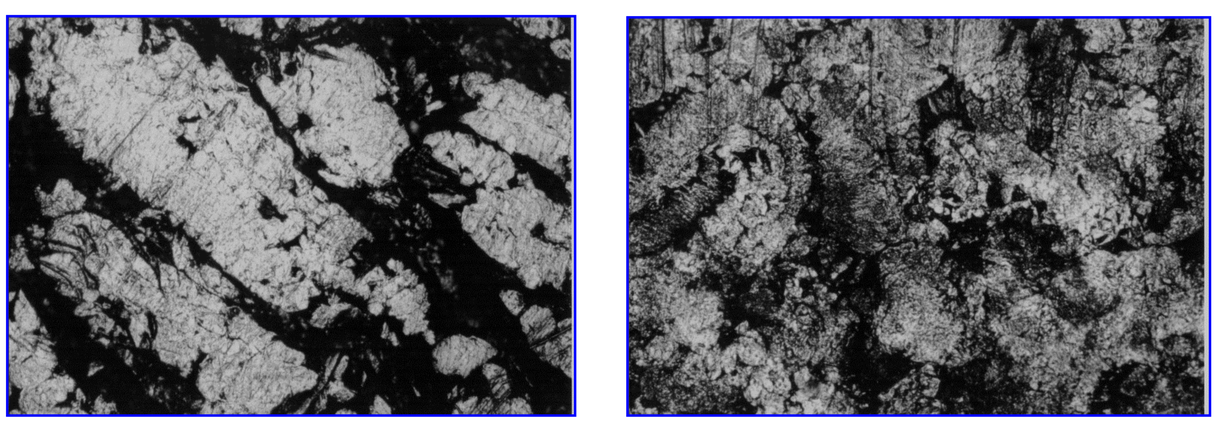
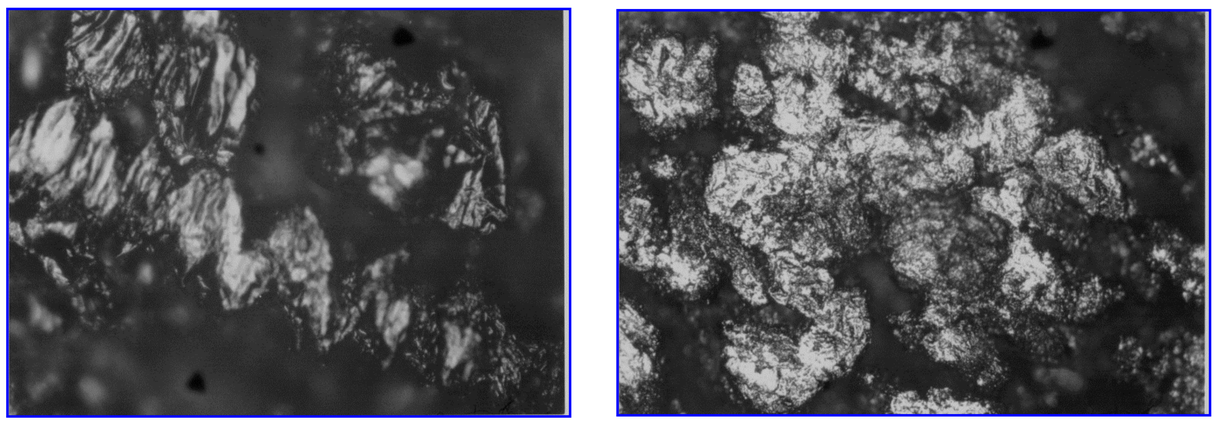
The main aim of the study was to search for the relationship between the anisotropy of the structure of polyfurfuryl alcohol (PFA) – polymer/compressed expanded graphite (CEG) – matrix composites at subsequent stages of the technological process and characteristics of the acoustic emission (AE) descriptors in these materials. These composites obtained after successive technological procedures of impregnation, polymerization and carbonization, possess different structure, densities, porosity and many other physical and chemical properties. In the structures of composites prepared on the basis of CEG, two basic directions can be distinguished: parallel to the bedding plane of graphite sheets and perpendicular to it. The stress was applied in these two main directions during the measurements. Investigations has shown that the AE method enables the detection of anisotropy in the structure of materials. The results of the research presented that all five of the acoustic emission descriptors studied in this work are sensitive to the technological stages of these materials on the one hand and to their structure anisotropy on the other. The conclusions resulting from the Fourrier analysis of the recorded spectrum are very interesting and provide a lot of information about the structure of composites as well as the bonds between the graphite matrix and the PFA polymer or turbostratic carbon filling the open pores.

Microstructure of the composites

(1) (2)

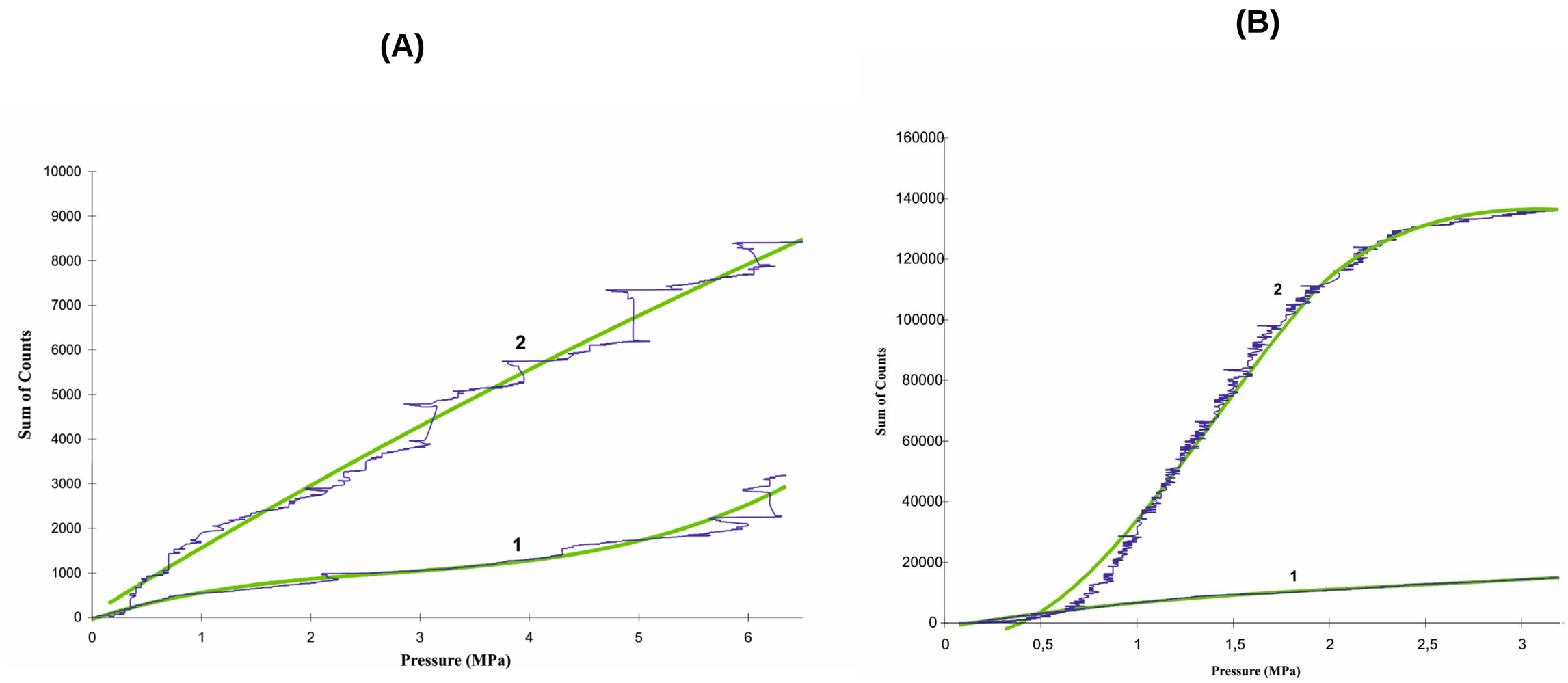


Microstructure of the compressed expanded graphite matrix, (d = 260 mg/cm^3),
(1) Cross-section, (2) Parallel to the bedding plane

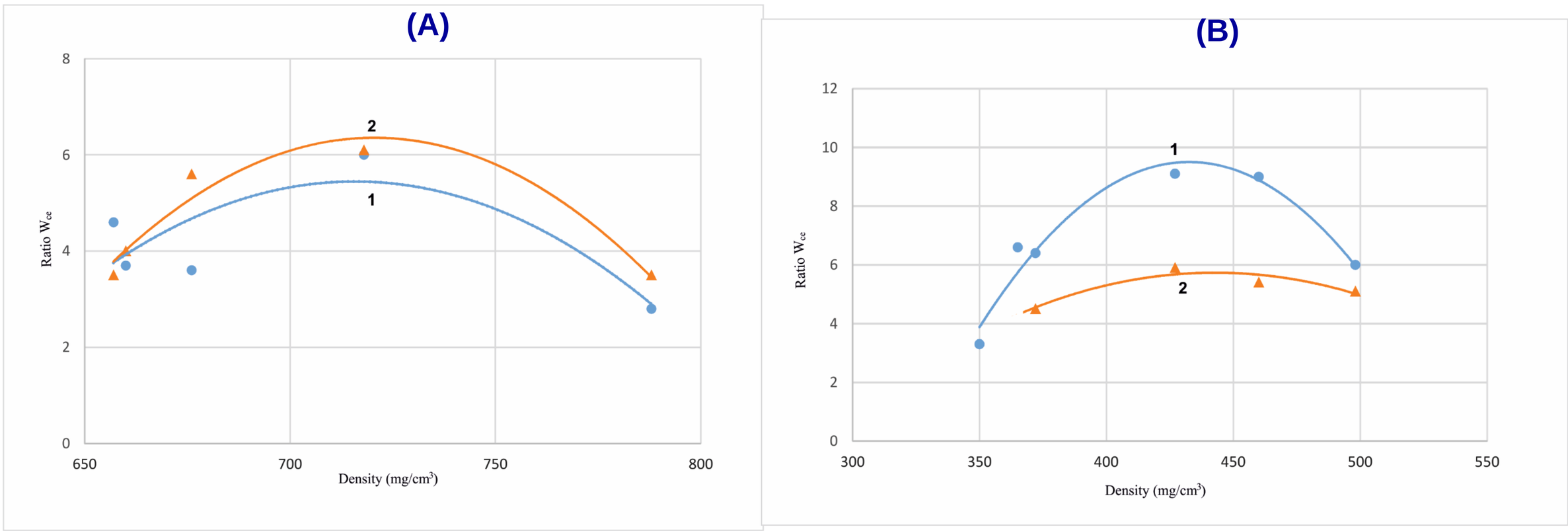


Microstructure of the CARB, (d = 498 mg/cm^3) composite,
(1) Cross-section, (2) Parallel to the bedding plane

The relationship between the composites structure anisotropy and the sum of counts or the sum of events AE pulses

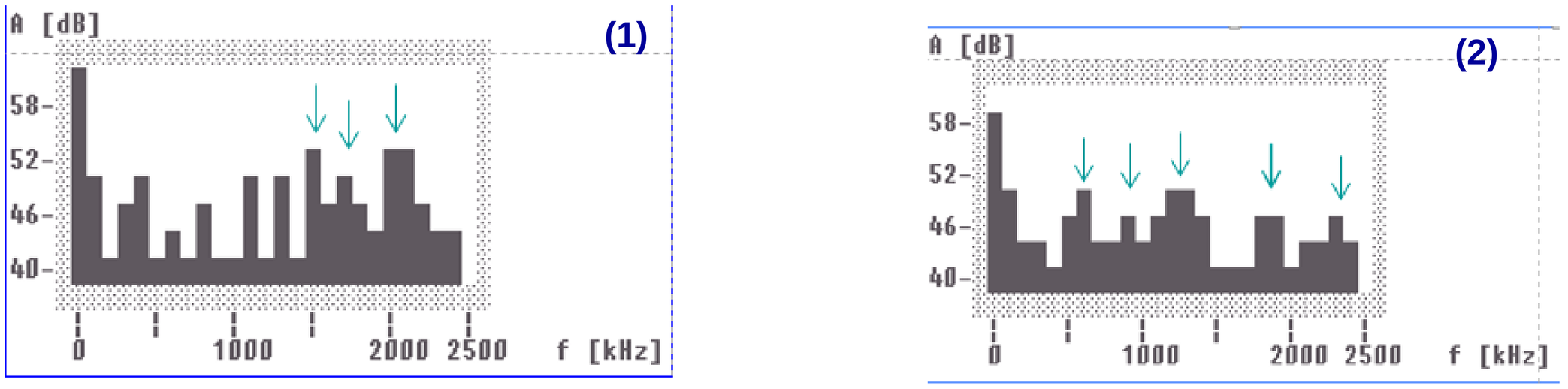


Sum of counts (ΣN_{cnt}) vs. pressure applied in the direction parallel - 1 or perpendicular - 2 to the bedding plane for (A) POL (d = 660 mg/cm³); and (B) CARB, (d = 498 mg/cm3) composites. Results of measurements - navy-blue curve, polynomial fitting - green line



Dependence of $W_{ce} = \Sigma N_{cnt} / \Sigma N_{ev}$ ratio on densities of (A) POL, (B) CARB composites, pressure applied in parallel-1 or perpendicular-2 direction to the bedding plane

Analysis of the spectrum distribution of AE waves depending on the anisotropy of the composite structure



Fourrier transformation of frequency distribution of AE waves for POL, (d = 660 mg/cm3) composites, pressure applied in the direction parallel (1) or perpendicular (2) to the bedding plane