crystals

Supplementary Materials

Comparison of Structural, Microstructural, Elastic, and Microplastic Properties of the AAAC (A50) and ACSR (AC50/8) Cables after Various Operation Periods in Power Transmission Lines

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S1. X-ray diffraction details

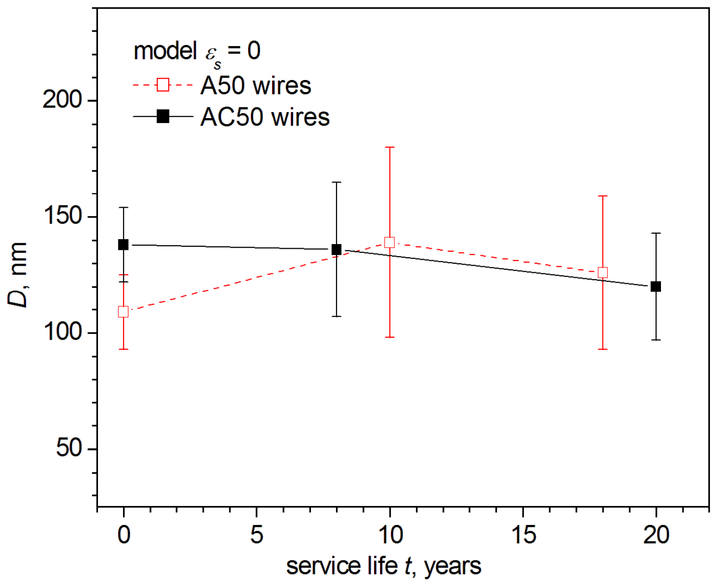

Figure S1. Comparison of dependences of the average crystallite size *D*, calculated within the framework of the zero microstrain model ($\varepsilon_s = 0$), on the service live duration *t* for Al-wires of A50 and AC50 type cables of the overhead power lines. The lines are guides to the eye.

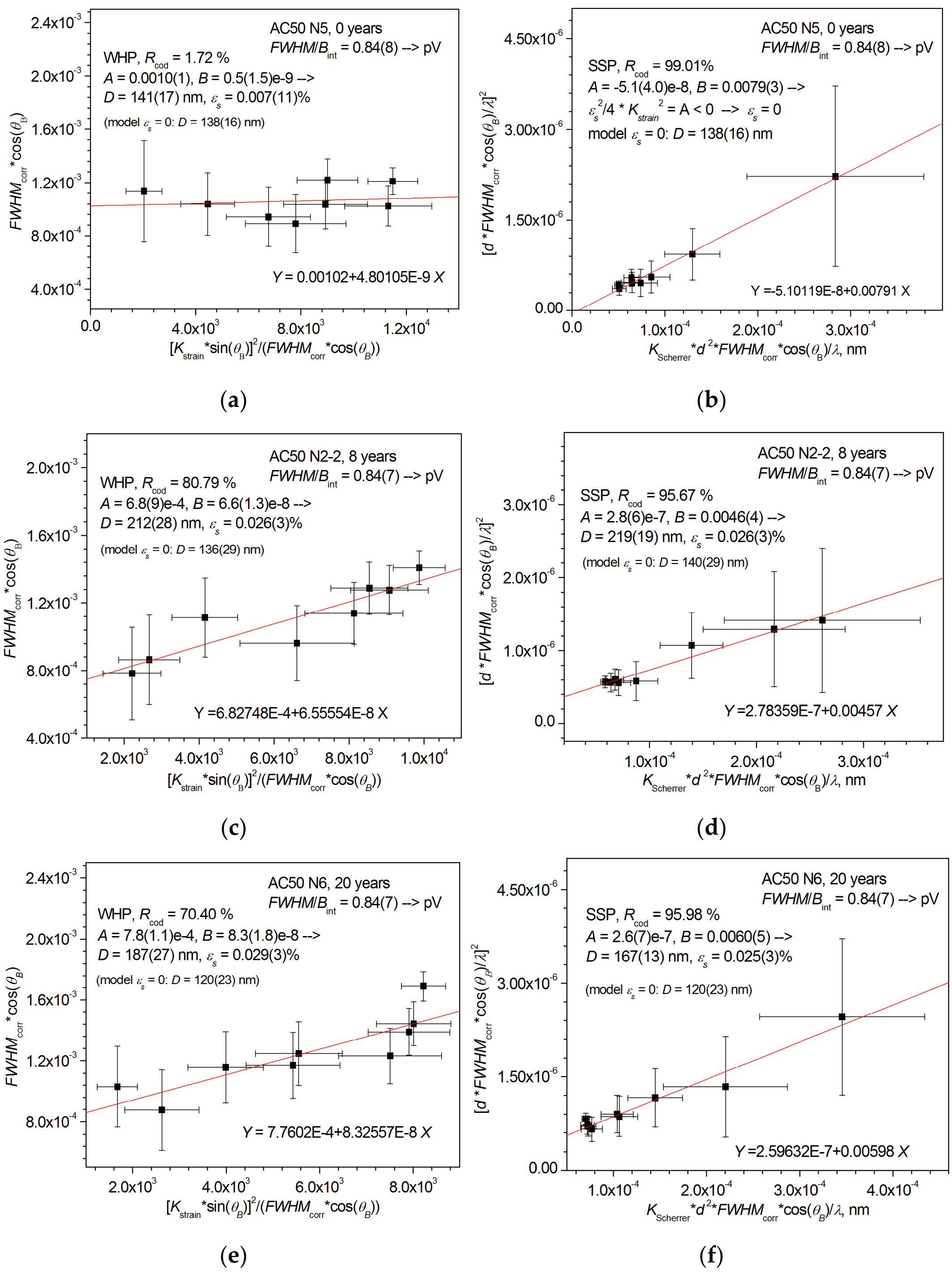

Figure S2. (**a**), (**c**), (**e**) WHP and (**b**), (**d**), (**f**) SSP of AC50 wires, without exploitation (**a**), (**b**) and after 8 (**c**), (**d**) and 20 (**e**), (**f**) years of exploitation. $FWHM_{corr}$ is full width at half maximum of the XRD reflection corrected to instrumental broadening, θ_B is half of Bragg angle $2\theta_B$ of the reflection after angular corrections applied, d is interplane distance corresponding to Bragg angle $2\theta_B$ of the reflection, $K_{Scherrer} = 0.94$, $K_{strain} = 4$, R_{cod} is coefficient of determination (see Ref. [1]), λ is the wave length of Cu-$K_{\alpha 1}$ radiation (1.540598 Å, after correction of Cu-$K_{\alpha 2}$ contribution). Equations of linear WHP/SSP graphs $Y = A + B \cdot X$, where X and Y are quantities shown in horizontal and vertical axes, respectively, are shown. Other designations are given in the text of the paper.

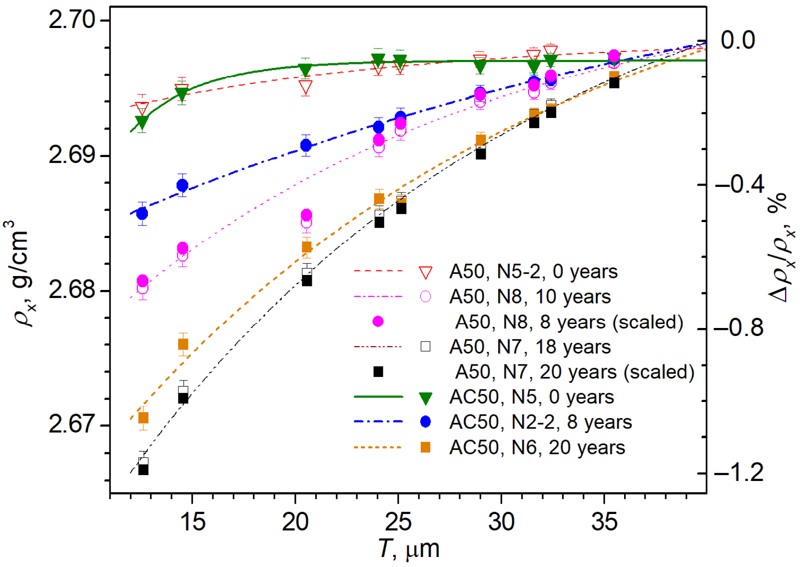

Figure S3. Distribution of the mass X-ray density $\rho_x(T)$ of the wire Al material along the depth *T* from the surface of the A50 and AC50 wires. Samples are numbered according to Table 2 of the paper and their livetimes are shown. At the right side, the axes are shown corresponding to the density defect $\Delta\rho_x/\rho_x$, which is estimated with respect to the bulk of the non-exploited sample of A50 type (N5-2, 0 years of operation). The approximation lines are drawn according to the exponential-decay law. The 'scaled' dependences are obtained from $\rho_x(T)$ for A50 wires (service lives of 10 and 18 years) by substraction/addition of corresponding quantity for 2 years, using the obtained rate of ρ_x change for A50 wires ($-2.52\cdot10^{-4}$ g/cm^3/years, see discussion of Figure 13(b) in the Section 3.4 of the manuscript).

References

1. Levin, A.A. Program *SizeCr* for calculation of the microstructure parameters from X-ray diffraction data. Preprint, **2022**. https://www.researchgate.net/profile/Alexander-Levin-6/research. doi: 10.13140/RG.2.2.15922.89280