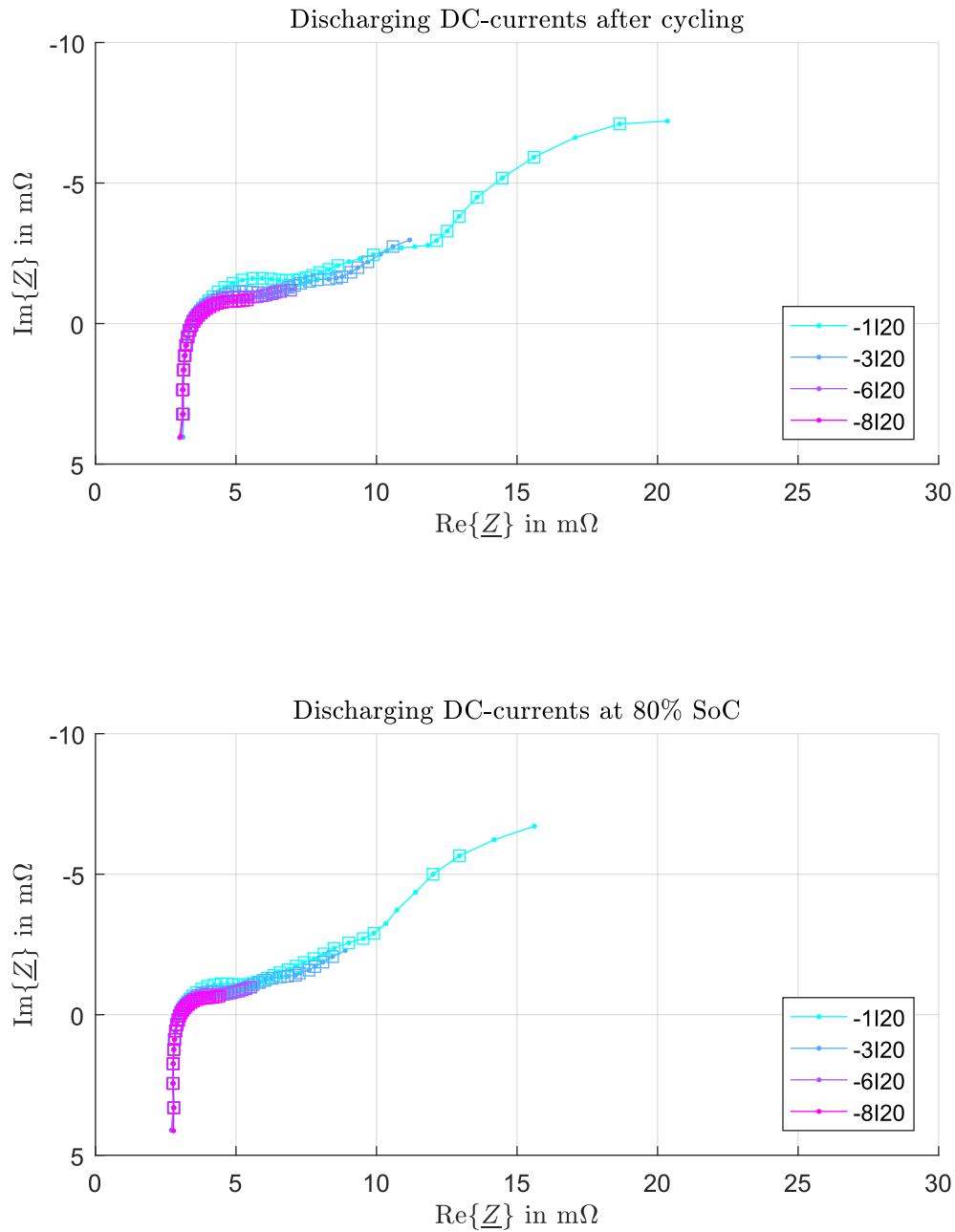


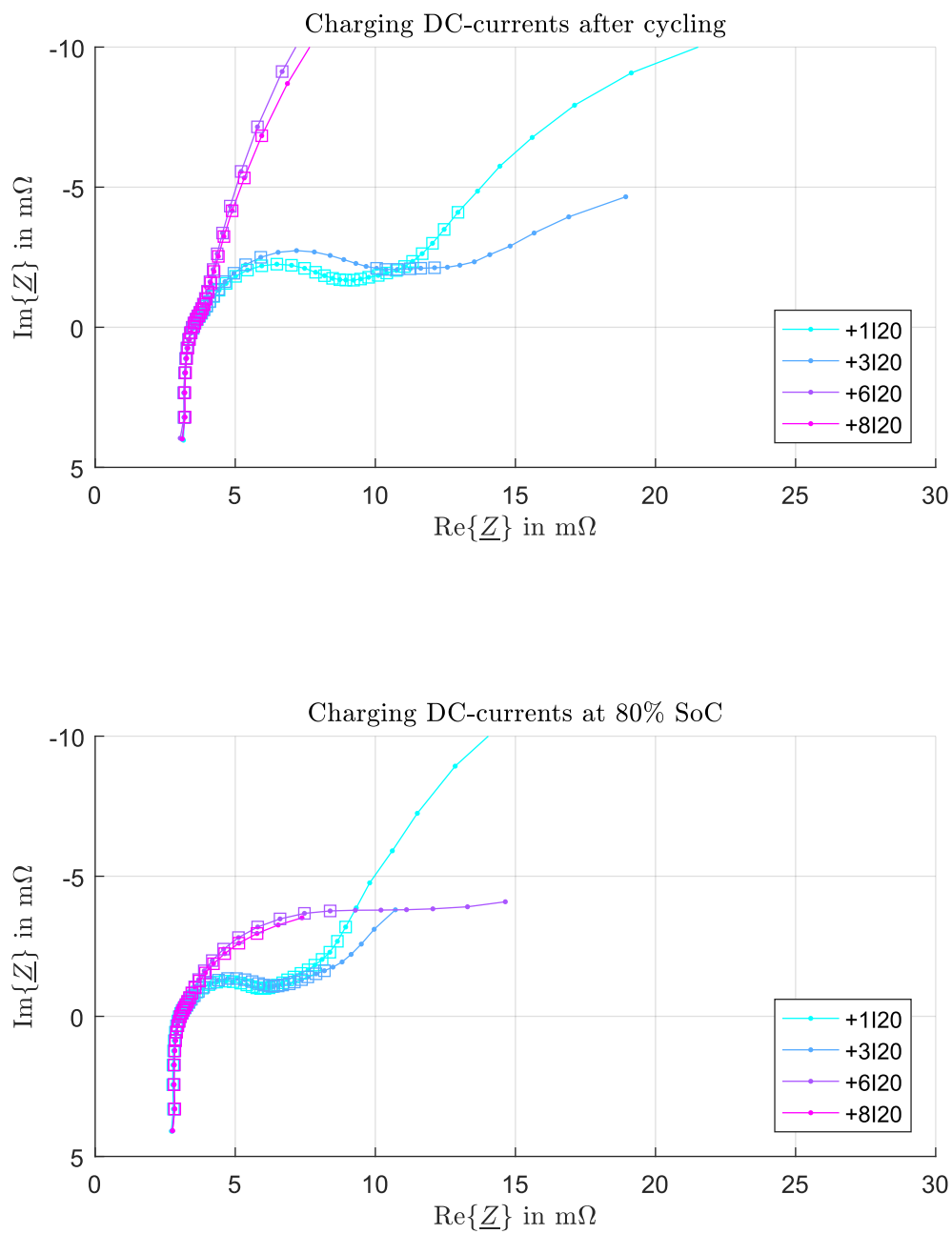
# **Supplementary Materials: Determination of SoH of Lead-Acid Batteries by Electrochemical Impedance Spectroscopy**

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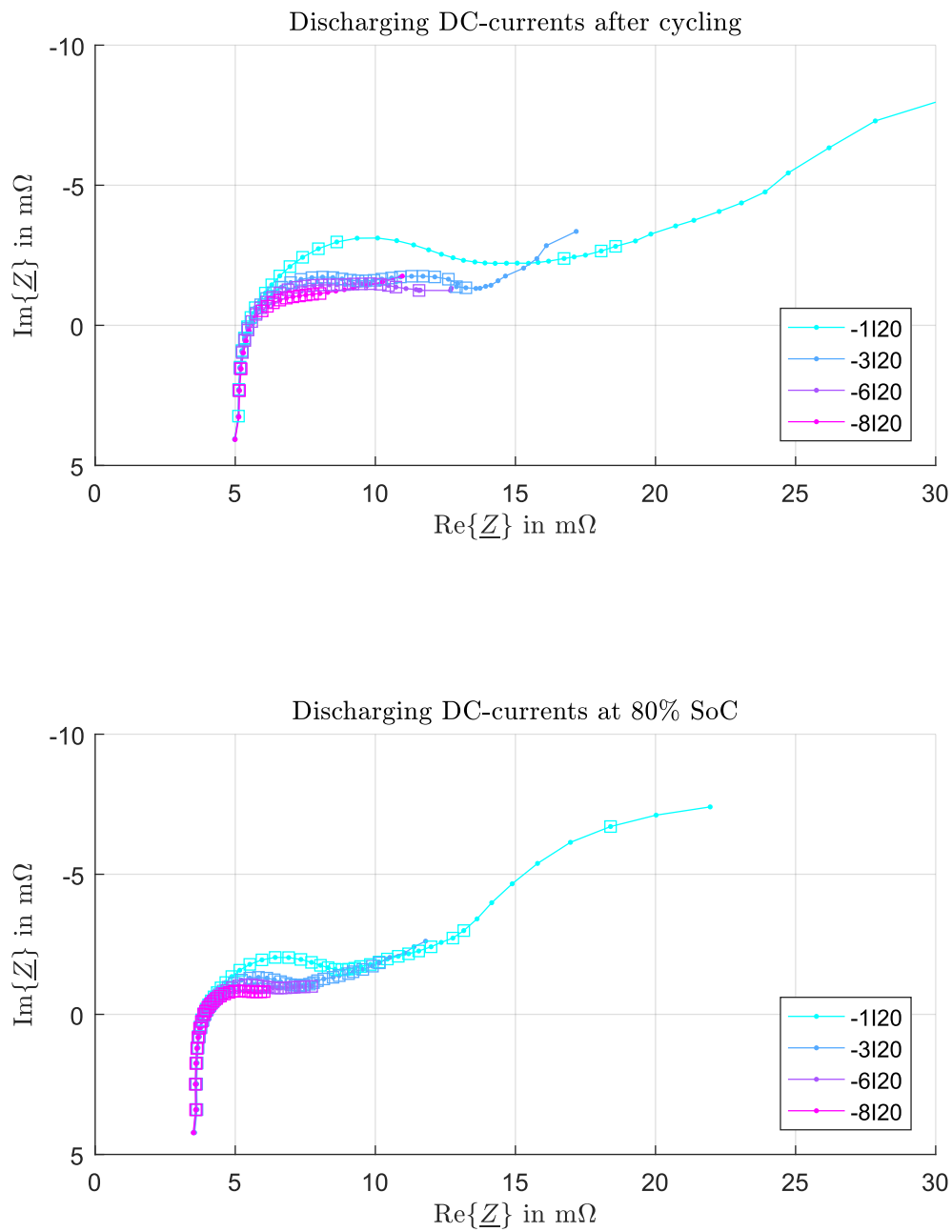
# 1. Impedance Spectra recorded during *Soft AK3.4*



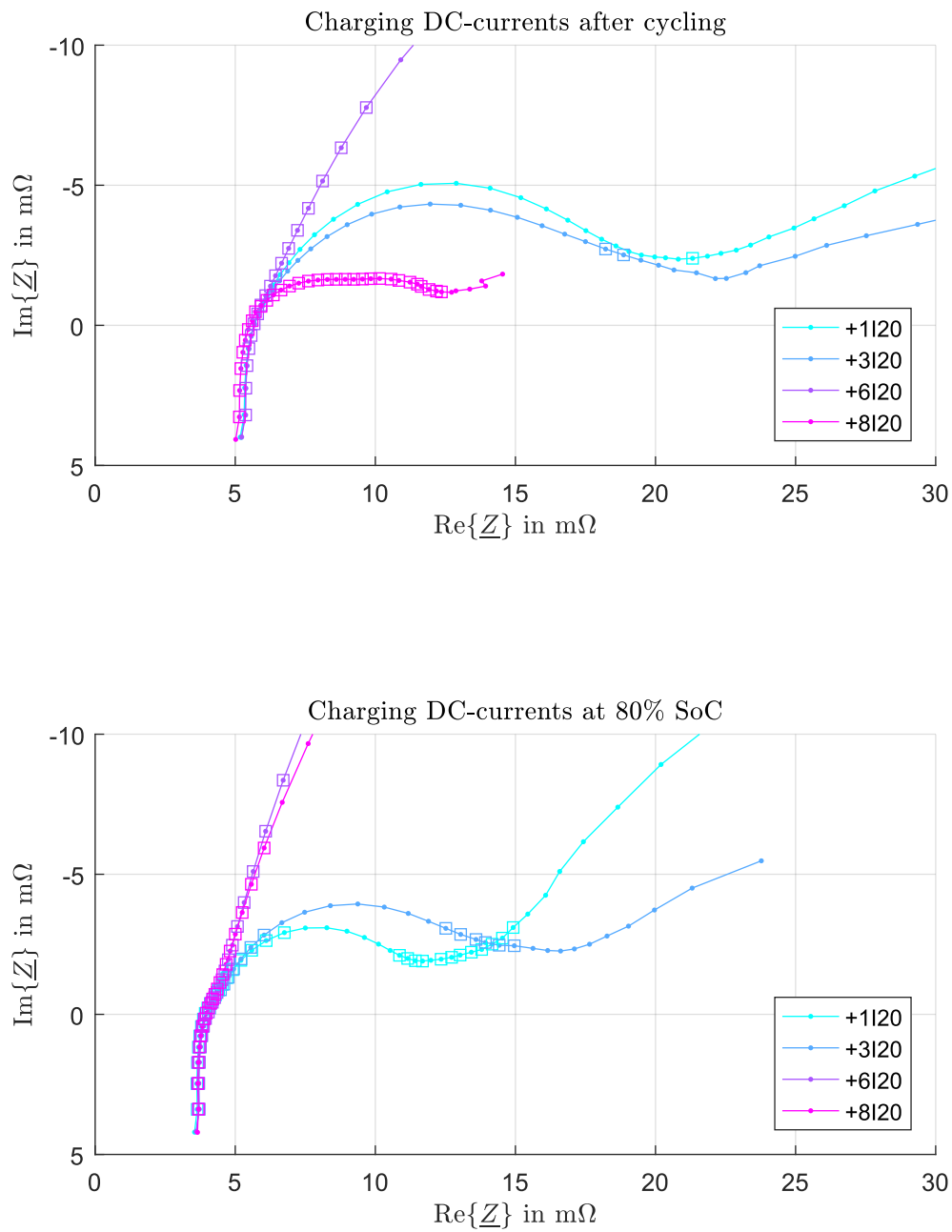
**Figure S1.** Impedance spectra measured on TC1 of *soft AK3.4* with superimposed discharging current after 15 FCE at the end of cycling phase and at 80%.



**Figure S2.** Impedance spectra measured on TC1 of *soft* AK3.4 with superimposed charging current after 15 FCE at the end of cycling phase and at 80%.



**Figure S3.** Impedance spectra measured on TC1 of *soft* AK3.4 with superimposed discharging current after 90 FCE at the end of cycling phase and at 80%.

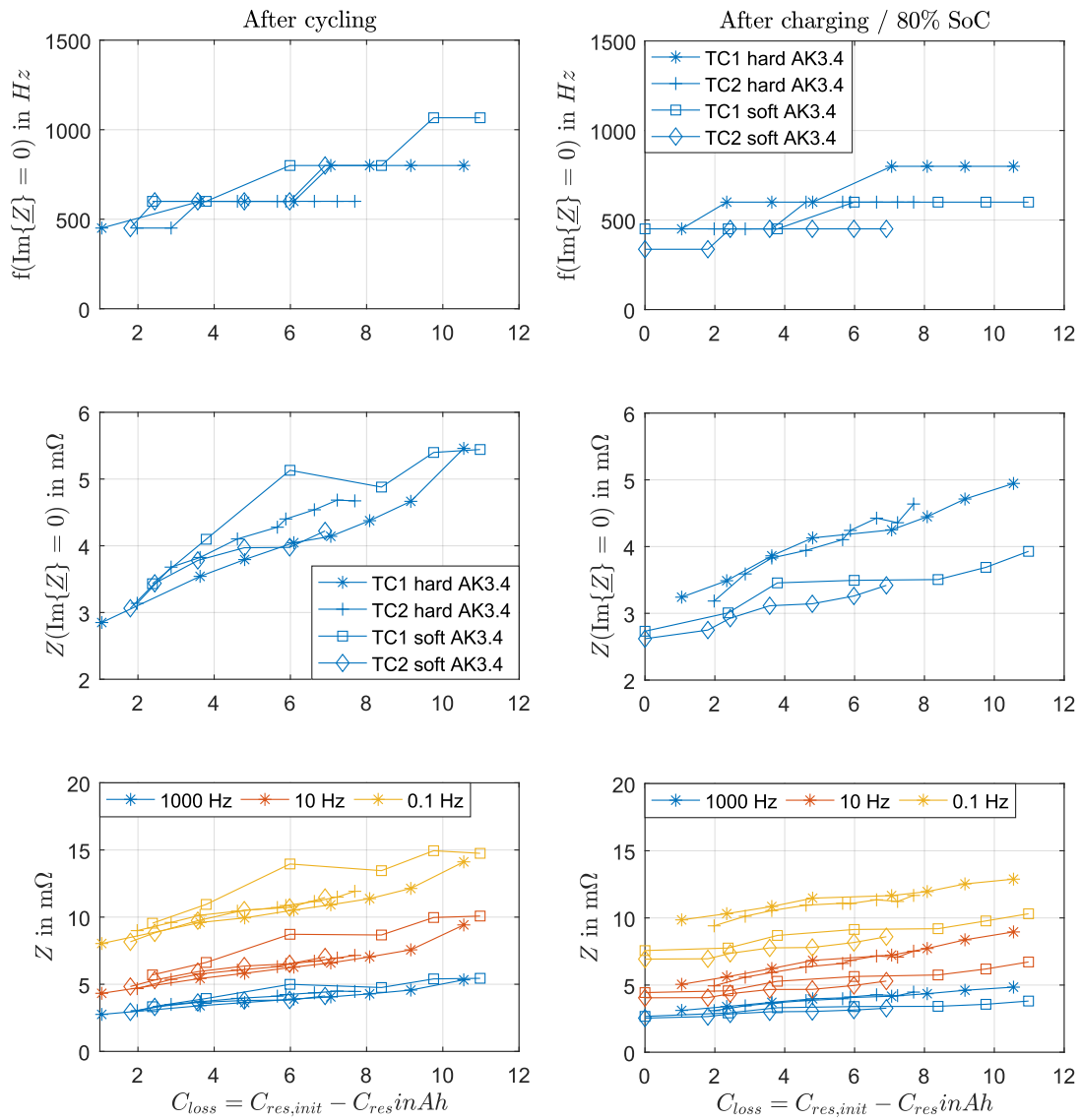


**Figure S4.** Impedance spectra measured on TC1 of *soft* AK3.4 with superimposed charging current after 90 FCE at the end of cycling phase and at 80%.

## 2. Single Impedance Values, further Results

**Table S1.** The average slopes of impedance amplitude increase over capacity loss  $C_{loss}$  for different frequencies and states from  $-3 I_{20}$  impedance spectra.

Frequencies	after cycling	after charging	80 % SoC
$f(Im\{\underline{Z}\} = 0)$	0.27 mΩ/Ah	0.179 mΩ/Ah	0.118 mΩ/Ah
1 kHz	0.27 mΩ/Ah	0.21 mΩ/Ah	0.115 mΩ/Ah
10 Hz	0.598 mΩ/Ah	0.411 mΩ/Ah	0.241 mΩ/Ah
0.1 Hz	0.698 mΩ/Ah	0.32 mΩ/Ah	0.25 mΩ/Ah



**Figure S5.** Single impedance values of all test cells in *hard* AK3.4 and *soft* AK3.4 test recorded with  $-3 I_{20}$  after cycling phase (left) and after charging (right). In in the upper graph the frequencies, at which the imaginary part of impedance is near zero, are plotted over capacity loss  $C_{\text{loss}}$  and in the middle graph the corresponding impedance amplitudes are given. In the lower graph impedance amplitudes measured at 0.1 Hz, 10 Hz and 1 kHz are presented. The data of different test cells are distinguishable by the marks and the different frequencies in the lower graph are distinguishable by the line color.