Supplementary material for

An insight of p-type to n-type conductivity conversion in oxygenion-implanted ultrananocrystalline diamond films by impedance spectroscopy

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S1: The complex impedance of UNCD films fitted by a double resistance-capacitance (RC) parallel and a resistance (R) model in series.

$Z=Z'-jZ'' $, (S1)

$Z^{'}=R\_{e}+\frac{R\_{g}}{1+ω^{2}R\_{g}^{2}C\_{g}^{2}}+\frac{R\_{b}}{1+ω^{2}R\_{b}^{2}C\_{b}^{2}}$ , (S2)

$Z^{''}=\frac{ωR\_{g}^{2}C\_{g}}{1+ω^{2}R\_{g}^{2}C\_{g}^{2}}+\frac{ωR\_{b}^{2}C\_{b}}{1+ω^{2}R\_{b}^{2}C\_{b}^{2}}$ . (S3)

When plotted in the complex plane, $Z^{'}$ versus $Z^{''}$takes the form of two semicircles in which the contributions of diamond grains and grain boundaries are easily identified, hence the electrical conduction paths of the bulk material can be studied separately.

Figure S1. Temperature dependence of resistance from I-V measurement of samples 900-A and O12900. Linear curve fitting from 20-100 oC shows activation energy values are 0.04 and 0.11 eV for samples 900-A and O12900, respectively.

