**Error model**

Data scatter added to theoretical impedance spectra was modeled as function of corresponding frequency and transepithelial resistance $R_T$. The model is based on standard deviations (SDs) of $Z_{re}$ and $Z_{im}$, respectively, which were modeled for each frequency and expressed as % of the DC resistance value.

For $Z_{re}$ at frequency $f$, a second-order Fourier series ($n=2$) was employed:

$$SD_{re}(f) = a_0 + \sum_{i=1}^{2} a_i \cdot \cos(nwf) + b_i \cdot \sin(nwf)$$  \hspace{1cm} \text{(Eq. S14)}

where $w=5.353 \times 10^{-5}$, $a_0=4.848$, $a_1=-4.11$, $b_1=-0.8092$, $a_2=-0.3583$, and $b_2=0.2014$ were determined as best fit to the measured data.

For $Z_{im}$ at frequency $f$, a fourth-order polynomial function ($n=4$) was used:

$$SD_{im}(f) = a_0 + \sum_{i=1}^{4} a_i \cdot f^i$$  \hspace{1cm} \text{(Eq. S15)}

where $a_0=0.189$, $a_1=0.0002737$, $a_2=1.863 \times 10^{-9}$, $a_3=-1.906 \times 10^{-13}$, $a_4=2.267 \times 10^{-18}$ were determined as best fit to the measured data.

To account for dependence of data scatter on $R_T$, $SD_{re}$ and $SD_{im}$ dynamics at 1.3 Hz were approximated by:

$$SD_{re}(1.3Hz) = 0.636R_T - 0.3278$$  \hspace{1cm} \text{(Eq. S16)}

$$SD_{im}(1.3Hz) = 8.7008R_T - 0.8689$$  \hspace{1cm} \text{(Eq. S17)}

This model was used to substitute $a_0$ in Eqs. A1 and A2 with $a_0(R_T) = a_0 + SD_{re}(1.3Hz)$ and $a_0(R_T) = a_0 + SD_{im}(1.3Hz)$, respectively, where $a_0$ (obtained from $R_T \approx 500 \ \Omega \cdot \text{cm}^2$) had been normalized by $SD_{re}(1.3Hz)$ or $SD_{im}(1.3Hz)$ obtained at $R_T \approx 500 \ \Omega \cdot \text{cm}^2$, respectively.