The linear fit of the logarithm of the data gives $\log A = -4.29 \pm 0.02$ with the current A expressed in μA and $B = 19.63 \pm 0.04\,V^{-1}$ (see Fig. 4b). The differences between these values and those obtained with the complete equation are rather small, confirming the feasibility of this common and straightforward processing of data, even if a simple analysis of residuals of the two models shows that the linearized one is less accurate in the full range investigated.

4.2. Deviations from the Shockley model

Fig.(5) shows the plot of $\log(I)$ *vs.* V for a larger range of V. The curve superimposed to the experimental data is the best fit obtained with the eq. (1), and it is evident that the two parameters model underestimates systematically lower values of the current and overestimates its higher values. A more realistic comprehension of the nature of the different contributions to the diode current requires therefore a study of these limiting regimes.

As explained above, besides the two parameters of the Shockley equation I_S and n, two supplementary parameters must be taken into account: G and R_s. If the series resistance is neglected, eq. (4) simplifies into:

$$I = GV + I_S(\exp BV - 1) \tag{5}$$

with I and V being the current and the voltage sensed at the diode leads, as before.

In ref. [14] the authors declare the unsuitability of the analysis of the forward I–V curve to find G and suggest the extraction of that parameter through a graphical

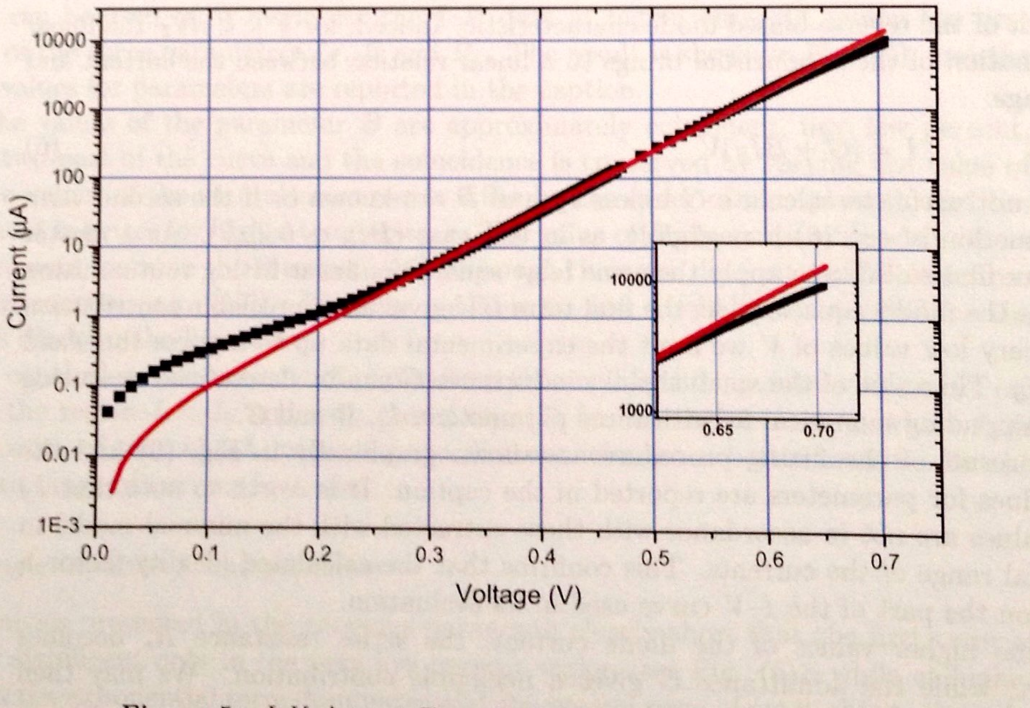

Figure 5. I–V data at $T = 47.8\,°C$ plotted in semi-logarithmic scale. The continuous line is the best fit curve obtained with the Shockley model with two parameters applied to the data with $2\,\mu A < I < 120\,\mu A$. The inset is a zoom of the high current data. It is evident that at very low currents ($I < 1\,\mu A$) and at high current ($I > 1\,mA$) the *minimal* model is not accurate.