Figure 9. $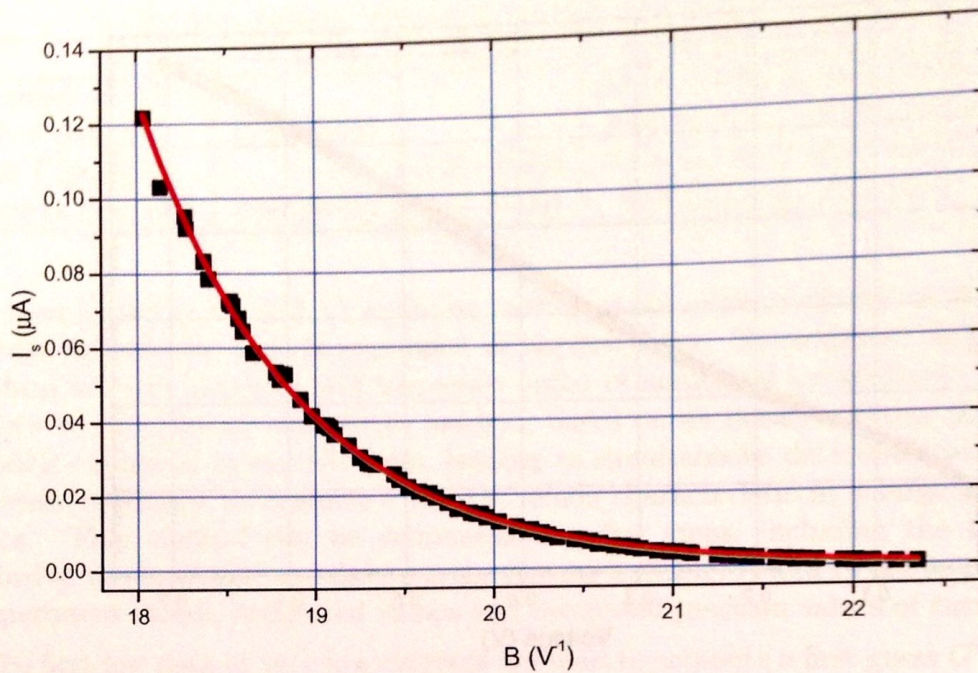I_S$ as a function of B for 100 I–V curves analysed with the iterative fitting procedure, described in the past subsection. The continuous curve represents the exponential *fit* with the simplified dependence $I_S = I_A e^{-BE_G}$. The agreement is rather good and the best value of the parameters are $I_A = 68 \pm 2\,A$ and $E_G = 1.117 \pm 0.002\,eV$. The latter is in very good agreement to the tabulated value of the gap energy in Silicon at temperature around 300 K.

on the doping levels. Based exclusively on [21], the 1N4148 is fabricated by growing a slightly doped ($< 10^{16}\,cm^{-3}$) $n - type$ Si micro-metric layer onto an heavily doped substrate n^+ at dopant concentration of $10^{19}\,cm^{-3}$. In the other side of n-layer it is then diffused an acceptor dopant forming a p layer with doping density of $10^{19}\,cm^{-3}$. With these levels of dopant a *band-gap narrowing* of several tens of meV is predicted and observed [22] and could conveniently be taken into account to adjust the expected value of E_G.

Our determination of E_G is based on an approximate model but conceivably the T^δ factor in the $I_S(T)$ relation should be considered. It is easy to understand that as that factor increases with temperature, the simplified model underestimates diode current at higher temperatures and the characteristic constants of the exponential in function of T lowers with respect to the value calculated without the exponential model:

$$I_S(T) = AT^\delta e^{-BE_G}$$

We take $\delta = 1.5$, which is the common choice for many different diodes, and the best fit gives for E_G the value of 1.040 ± 0.005 eV. The best fit A value results $A = 2.5 \pm 0.2\,mA/K^{1.5}$. The two parameters are strongly correlated so that an overestimation of the exponential characteristic constant involves an underestimate of the factor A and the E_G value is 80 meV lower than the one expected and with the disposable literature data [23]. This could be explained in terms of a high doping level at 2 to 3 x $10^{19}\,cm^{-3}$.