Since the resistance of the platinum nano-wires is proportional to their temperature { $R_w = \rho(T)\ell_w/A_\perp$ }, the differential cooling of the platinum nano-wires results in a small differential change in their resistance, $\Delta R_w(T)$. The two heated platinum nano-wires of the Microflown are connected together as half of a Wheatstone bridge, in which the junction point of the two platinum wires is connected to the base of an *NPN* bipolar junction transistor (BJT) operating as an (inverting) voltage amplifier in the so-called common emitter (CE) configuration, as shown in the figure below:

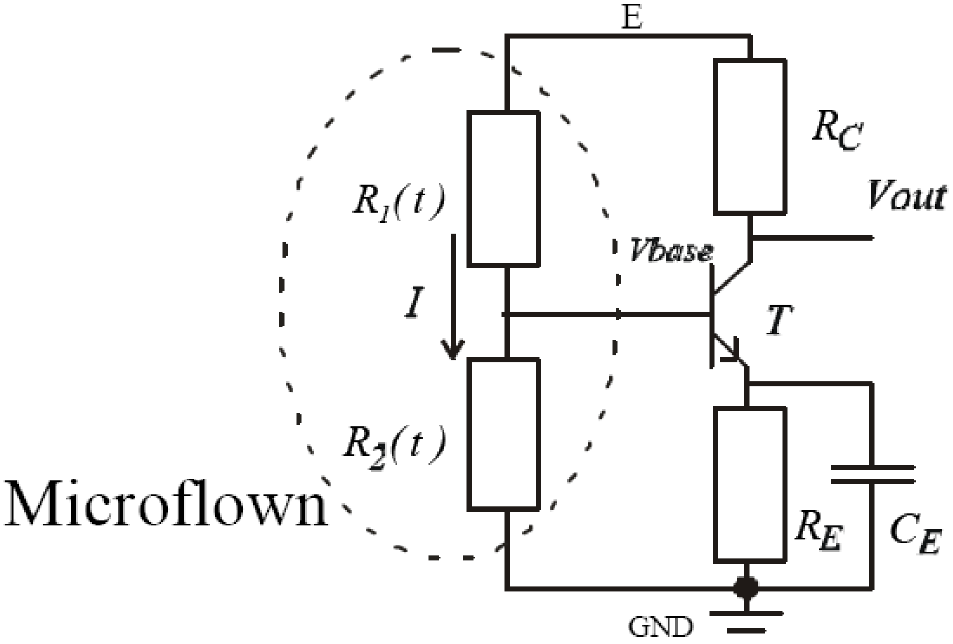

Fig. 13: CE configuration with a half Wheatstone bridge as input.

The voltage on the base of the BJT is: $V_b(t) = \tfrac{1}{2}E + I\Delta R_w(t)$. The BJT is used in this circuit as a voltage amplifier; the *AC* component of the output voltage on the collector of the BJT is $V_{out}^{AC}(t) \simeq -(R_C/R_E)\bullet I\Delta R_w(t)$, where the – sign denotes the 180^o phase shift of the inverting nature of the BJT CE voltage amplifier circuit.

The frequency and phase response of the Microflown are not flat. At low frequencies ($f < f_{bl} \simeq 100 Hz$), the sensitivity increases 6 *dB*/octave due to the effect of the thermal boundary layer on each of the platinum nano-wires. Between $100\, Hz < f < 1\, KHz$, the frequency response of the device is ~ relatively flat. The response at higher frequencies decreases due to heat diffusion effects (*i.e.* the time heat takes to travel from one wire to the other), with a corner frequency at $f_{difn} \sim 1\, KHz$, and a second high-frequency roll-off at higher frequencies occurs due to the heat capacity (*i.e.* thermal mass) of the platinum nano-wires with a corner frequency on the order of $f_{htcp} \sim 8 - 20\ KHz$ (depending on the device). The overall frequency and phase response of a Microflown device is shown in the figure below: