Lecture 12 (02.12.2020)

Mechanics of Nanowires

I. Equations of Motion

$$m\ddot{x} + \Gamma\dot{x} + kx = F_{th} + F_0$$

For NW:

$$m\ddot{r}_1 + \Gamma_1\dot{r}_1 + k_1 r_1 = F_{th,1} + F_{0,1}$$

$$m\ddot{r}_2 + \Gamma_2\dot{r}_2 + k_2 r_2 = F_{th,2} + F_{0,2}$$

$$m\ddot{r}_i + \Gamma_i\dot{r}_i + k_i r_i = F_{th} + F_i$$

$$F_i = F_{0,i} + \frac{\partial F_i}{\partial r_i} r_i + \frac{\partial F_i}{\partial r_j} r_j + \cdots$$

$$m\ddot{r}_i + \Gamma_i\dot{r}_i + k_i r_i = F_{th} + F_{0,i} + \frac{\partial F_i}{\partial r_i} r_i + \frac{\partial F_i}{\partial r_j} r_j$$

for $i = 1, 2$

$i \neq j$

$$m\ddot{\vec{r}} + \tilde{\Gamma}\cdot\dot{\vec{r}} + \tilde{k}\cdot\vec{r} = \vec{F}_{HG} + \vec{F}_0$$

$$\tilde{\Gamma} = \begin{pmatrix} \Gamma_1 & 0 \\ 0 & \Gamma_2 \end{pmatrix}$$

$$\tilde{k} = \begin{pmatrix} k_1 - \frac{\partial F_1}{\partial r_1} & -\frac{\partial F_2}{\partial r_1} \\ -\frac{\partial F_1}{\partial r_2} & k_2 - \frac{\partial F_2}{\partial r_2} \end{pmatrix}$$