Course: Nanostructured Materials

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2020-11-14	**Lecture 1, Introduction:** Introduction to nanostructured materials mainly from the perspective of nanoelectronics, brief history of the microelectronics industry, specifications and fabrication of wafers (mainly Si), clean rooms **Problem Based Learning (PBL) assignment:** First exploration of the concepts behind fabricating "bottom-up single-electron transistors", investigate various fabrication techniques required
2020-11-21	**Lecture 2, Top-down fabrication:** optical lithography, photomasks, diffraction limited resolution, resolution enhancement tools, lithography types (contact, proximity, projection), optical systems and light sources, mask aligners and steppers **Problem Based Learning (PBL) assignment:** Top-down fabricated part of the "bottom-up single-electron transistors"
2020-11-28	**Lecture 3, Top-down fabrication:** Other top-down lithography techniques (x-ray, e-beam, ion beam, nano-imprint, …), wet and dry etching, isotropic and anisotropic etching **Problem Based Learning (PBL) assignment:** Group presentations of top-down fabricated part of the "bottom-up single-electron transistors"
2020-12-05	**Lecture 4, bottom-up fabrication:** Surface functionalization, various form of assembly, self-assembled monolayers (SAMs) on noble metals (Au) , synthesis of Au nanoparticles (NPs), CdSe NPs, semiconductor nanowires **Problem Based Learning (PBL) assignment:** Bottom-up fabricated part of the "bottom-up single-electron transistors"
2020-12-12	**Lecture 5, Bottom-up fabrication:** Carbon based nanomaterials (graphene, carbon nanotubes, fullerenes), metal chalcogenite and BN 2D materials and nanotubes **Problem Based Learning (PBL) assignment:** Group presentations of bottom-up fabricated part of the "bottom-up single-electron transistors"
2020-12-19	**Lecture 6, Properties:** Electronic (band) structure of materials (brief reminder), quantum confinement (using a simple particle-in-a-box model), implications for electronic and optical properties of e.g. quantum wells and quantum dots **Problem Based Learning (PBL) assignment:** Modelling of Quantum confinement in semiconductor nanoparticles
2020-12-26	Self study
2021-01-02	**Lecture 7, Transport:** Single electron tunneling in single electron transistors and quantum dots, charging energy, Coulomb blockade **Problem Based Learning (PBL) assignment:** Group presentations on Modelling of Quantum confinement in semiconductor nanoparticles