### Ph.D. Pre-submission Seminar

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**Title of the Thesis**: Synthesis of novel Naphthyl diimides and Phenanthroimidazoles [9,10-d] benzimidazoles for Field-effect Transistors
**Date and Time**: 12.12.2019 and 3.30 p.m.
**Venue**: Conference Hall, Department of Chemistry, CUTN

### Abstract

Advancements in the field of organic electronic materials and devices have resulted in the development of new solution-processable high-performance small molecules and polymers. Organic semiconducting molecules possessing p-type behaviour have been successful in device fabrication. In contrast n-type semiconducting molecules owing to their solubility, stability and LUMO levels face problems in device operations. Strategies involving structural modifications, incorporation of alkyl chains and introduction of electron accepting systems are developed to tune the energy levels of n-type semiconducting molecules. Good solubility of the compounds, assembling behaviour, electron delocalisation, thermal stability and film forming capacity are essential requirements for achieving enhanced device operations. Among various devices, organic field-effect transistors (OFETs) showed the most noticeable applications owing to their easy structural integration, non-destructive reading, and multiple-bit storage in a single transistor. Bottom gate/top contact architecture of the OFETs are preferred over the other OFET architectures as it reduces the source and drain channel length, provides environmental stability, ease of dielectric and active layer coating and facilitates in obtaining high charge carrier mobility. Solution processing methods, such as spin coating, drop casting, inkjet printing have substituted conventional techniques of photolithography, thermal evaporation and vacuum deposition leading to low-cost fabrication and maximum output. Imides and imidazoles are well known n-type semiconducting molecules for their application in fluorescence recognition and optoelectronic behaviour. Owing to their strong accepting behaviour and amorphous nature, their application in OFET behaviour is not explored widely. This research work is aimed at structural engineering of 1,8- naphthalamides (NIs) and phenanthroimidazoles to achieve better self-assembling behaviour and higher efficiency of OFETs. Functionalisation of NIs involved the incorporation of conjugated groups with different linkers such as single/double/triple bonds. Functionalized NIs with triple bond linkers resulted with noticeable aggregation induced enhanced emission behaviour in binary solvent system of THF/H2O. Introduction of formyl group to the NIs resulted in reasonable LUMO value that can be beneficial for OFET behaviour. Phenanthroimidazoles were functionalized with electron donating conjugated systems at the imidazole ring. The molecules were designed in a donor-acceptor framework in order to achieve a balance of charge carriers that facilitates enhanced mobility of the OFETs. Solution processed bottom gate/top contact OFETs were fabricated. Active layer deposition was performed using binary solvent system, chloroform/toluene (1/1) followed by thermal annealing. OFET results with high mobility of 0.70 cm2/Vs, ON/OFF ratio of 10² and threshold voltage of -6V was obtained. The findings prove the molecules with excellent potential for various electronic applications such as memory devices, sensors and switches.

### References