In this thesis I report the design and fabrication of well aligned repeatable multilayered gold and silver chiral metamaterials of high uniformity in the 100nm scale which show significant circular dichroism in the visible range. Two layered Dolmen structure, two layered ‘L’ structure, three layered 3-4-5 right-angled-triangle structure, and three layered ‘V’ structure are successfully fabricated, which allows possible applications in wave-plates and circular polarizers. These samples are produced by an e-beam direct write technique with a precise multi-layer alignment control and a lift-off process. 30nm thick SiO2 and 60nm thick maN2401 photo resist are implanted as buffers between the layers. The experimental results are well matched with simulations using a finite-integration technique from CST microwave studio.

None of the structures show circular dichroism upon first layer fabrication due to the achiral property of single layer, except for the single layer 3-4-5 right-angled-triangle structure which processes 2-D chirality. All the multilayered structures exhibit large circular dichroism showing qualitatively the same shape upon opposite incident direction because of the handedness of structures; and with deviations due to the presence of the substrate and buffer layers. Within the first few layers the CD increases with number of layers, unveiling the importance between 3-D chirality and optical activity. The mastering of alignment technique is important for successful fabrication of multilayered optical metamaterials. This project achieves precise multi-layers alignment control which is difficult and challenging.

Date: July 22, 2013 (Monday)
Time: 9:30am
Venue: Room 4472 (via Lifts 25-26)
Academic Building, HKUST

All interested are welcome!