Technology advancements in microwave systems demand for high performance electronic devices. This leads to the creation and development of new microwave filter topologies to achieve better selection and control of response. Ring based filter topologies become immediately attractive options as they offer dual resonance in their response which will ensure high selectivity and physical compactness of the filter. However, in some cases, the ring filters do not come with complete mathematical synthesis, making them difficult to design and to be generalized at higher order. This thesis introduces a single mode ring resonator, fed via one of the resonator’s quarter-wavelength coupled-line for simplification, with less control parameters. A global synthesis is developed to fix the transmission zeros and experiments are conducted to prove the validity of the synthesis and subsequently can be generalized for higher-order filters. To prove this concept, higher-order filters were realized by cascading the single mode ring to form multiple cells and additional coupled-lines were introduced in the structure to create additional poles. The global synthesis of the single mode ring was applied to demonstrate the flexibility of the single mode ring topology and its synthesis. Higher-order filters of up to 5th-order were implemented in the range of 1 GHz to 2 GHz to give a different range of fractional bandwidth between 10% - 26%. Further advancement on the application of single mode ring topology is presented in this thesis for reconfigurable filter application. By manipulating the electrical length of the ring lines using external tunable elements, the electrical length of the ring was varied, hence, shifting the frequency response to a desired position. The reconfigurable filter with its tunable scheme synthesis was developed to control the frequency response at arbitrary center frequency. Based on this reconfigurable concept and its synthesis, two reconfigurable designs were achieved using two different techniques. The first technique made use of lumped capacitors and was successfully reconfigured from 2 GHz to 984.4 MHz; while miniaturisation achieved up to 71% as compared to the conventional filter designed directly at 1 GHz. The second design made use of varactor-diodes and shifted the resonance frequency from 1.10 GHz to 1.38 GHz, spreading over 280 MHz frequency range to give 25% tuning range with fractional bandwidth below 9%. All the filters were realized using microstrip technology. The simulated and measured results are then presented and compared to demonstrate the excellent performance of the proposed filters.

This study is carried out to investigate the properties of copper iodide (CuI) thin films deposited by using a novel-mist atomization method. The properties of CuI thin films studied in this research are structural, morphological, electrical and optical properties. The new deposition method of CuI thin films which is by using mist-atomization technique is carried out in order to find the suitability of CuI thin films as a p-type hole conductor for the fabrication of solid-state dye sensitized solar cells (ss-DSSCs). The CuI solution was prepared by dissolving the Cu powder in acetonitrile and deposited onto the conducting glass substrate. Several parameters investigated which are deposition flow rate and frequency, spraying method, substrate temperature, molar concentration and doping concentration to get an optimized film. All of the investigated parameters were carried out by using mist-atomization technique. The nanostructured CuI exhibit a 2-dimensional and quantum confinement effects that lead to improved properties. Further investigations reveal that the 0.05 M of CuI concentration sample was the most conductive sample of 3.93 Scm⁻¹ with the highest crystallinity, which then becomes the set of parameters to be applied in the fabrication of solid-state dye sensitized solar cells (ss-DSSCs). Then, the two set of parameters of molar concentration and doping concentrations were carried out to the next part of the research which is the fabrication of ss-DSSCs (TiO₂/dye/CuI). In this part, the CuI thin films were fabricated on top of dye-anchored TiO₂ layer using a novel mist-atomization method. Therefore, in order to understand the photovoltage behavior, four different parametric studies are conducted. The solar cells efficiencies show same relations with the results obtained in the thin film properties section. It is observed that 0.05M of CuI solution concentration gives the best device efficiency of 1.05% as compared to other parameters. While low device efficiency for cells fabricated with doped CuI thin films was observed when compared to the undoped CuI thin films. From the results, it can be concluded that the nano sized of CuI particles which matched to the porous structures of TiO₂ layer and electrical conductivity are the main properties contributed to the ss-DSSCs device efficiency.