The possibility of use cold cathodes as an electron source in vacuum tube device has been already demonstrated [1]. Using cold cathodes instead of thermionic ones could have many advantages [2], in particular it can increase the efficiency of the tube system since the power consumption of the cathode heater is neglected. For the realization of electron gun with cold cathode an extracting grid near the field emitters is necessary in order to obtain current emission.

In this work a new realization approach, as alternative to classical Spindt Type FEA, for integrating CNTs cathodes in electron gun will be shown. The use of an external grid can have some advantages respect to integrated grid cathode such as ease of realization, or the possibility to apply higher voltage without have dielectric breakdown of the spacer between cathode and grid.

Carbon nanotubes cathodes with an external grid have been realized. The realized cathodes are formed from a silicon substrate that has a CNTs circular pattern with radius in the range of 200-250 µm. As extracting grid a commercial TEM grids has been used. The used grids are in molybdenum with an external diameter of 3.05 mm and a thickness of 25 µm. The pitch of the grid is 85 µm, the bar width is 31 µm and the hole width is 54 µm. The grid geometrical transparency, defined as the ratio between the holes area and the total grid area, is 40 %. A micrometric spacer, with a thickness of 50 µm, is used to place the grid over the emitting area.

Measurements of a realized cathode with external grid have been performed for a fixed grid-anode voltage of 500 V and a cathode-grid voltage from 0 V to 900 V. The maximum anode current achieved is 4 µA that correspond to a current density of 3.2 mA/cm². The field enhancement factor ($\beta$) calculated considering a cathode-gate distance of 50 µm is 2043. The electron transparency, calculated as the ratio between the anode current and the whole emitted current, reach a minimum of about 75 % at 900 V of grid voltage. The current densities obtained from preliminary results are still not suitable for vacuum tubes, however higher voltage can be easily applied to the extracting grid permitting to reach current densities competitive with thermionic cathodes.