Straight carbon nanotubes have attracted significant research for their capability of enhancing the mechanical, electrical and thermal properties of a host polymer matrix. However, there is a lack of research on the incorporation of helical carbon nanotube into the polymer matrix. The helical configuration of carbon nanotubes could greatly improve the fracture toughness and mechanical strength of the composites. In this study, helical carbon nanotube-based thermoplastic nanocomposites were fabricated through spray deposition process. Helical carbon nanotube paper was made first by spraying helical carbon nanotube suspension and then thermoplastic resin was sprayed on the paper to make the final nanocomposites. This process is capable of making a thin sheet of thermoplastic nanocomposites with high carbon nanotube loadings. The smallest thickness can be 30~40 um. The thermal properties of the thermoplastic nanocomposites were studied via thermo gravimetric analysis. The thermo-mechanical properties were determined using DMA. Scanning electron microscopy studies were employed to investigate the dispersion and interlocking of the helical carbon nanotubes in the polymer matrix.