The preparation of different single and bimetal-NPs dispersed carbon nanofibers (CNF) were successfully synthesized using CVD process. The cytotoxicity of the CNFs was also observed. The polymeric nanocomposite was successfully synthesized using PVA and CAP as an encapsulating agents for nano-antibiotics drug delivery system. In conclusion the prepared materials were successfully applied for different application such antibacterial agents, nano-antibiotics in drug delivery system, wound healing, and agricultural applications.

The materials was tested for in-vitro cytotoxicity tests indicated that the prepared ACF/CNF materials dispersed with Cu or Ag NPs had comparable or less toxicity compared to commercial carbon-based nanomaterials, such as CNTs and GAC. The sonicated samples exhibited less toxicity than their non-sonicated counterparts. The presence of metals on the surface of fibers was associated with the ability to generate reacting oxygen species. The cytotoxicity depended on the metals and its types, as evident from the MTT assay data. The cells viability on different ACF-based materials (ACF substrate and Ag/Cu-ACF/CNF with and without sonication) depended upon the surface charge, whereas there was no clear correlation observed for the commercial materials. Relatively larger positive surface charge caused less cytotoxicity, attributed to the ability of the material to generate free radicals at positive surface charge, leading to cells injury. The DNA fragmentation analysis showed that greater DNA damage occurred to the cells exposed to the GAC and CNTs. The fluorescence microscopy images corroborated the finding that the extent of the cell death caused by the swelling of the mitochondrial membrane was less in the ACF/CNF than in the CNTs. This study confirms the safe application of ACF/CNF, in particular as an adsorbent for environmental remediation applications and different biomedical applications.

In this context, the prepoared single and bi-metals (Cu-Zn)-ACFs/CNFs were synthesized for biomedical applications including infectious diseases, mainly for the use as a nano-antibiotic. The prepared (Cu-Zn)-ACFs/CNFs was effectively applied against different bacterial strains especially \textit{E. coli}, \textit{S. aureus}, and \textit{MRSA}, which are main causes of the infectious diseases. The asymmetrical distribution of metal NPs, Cu-NPs formed the fibers while Zn-NPs remain adhere on the ACFs surface. The
controlled release of Cu-NPs and robust release of non-toxic Zn-NPs makes early and prolonged effectiveness of the materials. The combination of metal-NPs improved efficiency as well as biocompatibility of the materials. The prepared (Cu-Zn)-ACFs/CNFs is biocompatible, and has the potential material to be safely used as nano-medicines against infectious diseases. Thus the prepared materials encapsulated with the PVA-CAP polymers.

PVA-CAP-Cu-ACF/CNF, a composite of polymers, metal NPs and carbon micro-nanofibers was synthesized for drug delivery applications, in particular used as an antibacterial agent. PVA-CAP was used as an encapsulating agent for Cu-ACF/CNF. The latter was in-situ dispersed in the polymeric matrix during a polymerization stage. The SEM analysis confirmed a uniform dispersion of Cu-ACF/CNF within the porous structure of the prepared composite material whose external surface was rough and non-porous. PVA-CAP-Cu-ACF/CNF was found to be dispersible in water at pH > 6.5, slowly releasing Cu-ACF/CNF. Cu NPs were effectively applied as antibiotics against both gram negative *E. coli* and gram positive *S. aureus* bacteria, which are innately present in many infectious diseases. The rate of dissolution increased with increasing amount of CAP in the polymeric blend. The prepared biomaterial has potential to be used as a polymeric carrier for the controlled release of nanomedicines for different drug delivery applications including wound healing.

On the other hand, prepared CNF was effectively used in different aspects excluding biomedical application. In this context, CNF was also successfully applied in agricultural crops improvements. A novel metal NPs-carbon composite (Cu-CNFs) was synthesized as an efficient growth stimulant for crops, with the material providing carbon and Cu as nutrients to plants. The Cu-CNFs enhanced the water uptake capacity of seeds, and the germination rate and growth of the seedlings. The significant increase in root and shoot lengths, and the chlorophyll and protein contents in the *Cicer arietinum* and *Vigna radiata* plants indicated the efficiency of the Cu-CNFs as a growth stimulant and a nutrient. The effective translocation of the Cu-CNFs within the plants was associated with the negatively charged surface of the material, corroborated from the SEM analysis, elemental mapping and fluorescence
imaging. The CNFs held the Cu NPs at their tips, thus acting as a carrier of the Cu NPs, and also, facilitating a slow release of the NPs within plants. A high water uptake capacity of the seed suggested that the Cu-CNFs may be used as an efficient growth stimulant for the production of pulses under water scarce conditions, and in general, for improving crop yields.

In the continuation of agricultural application, a novel polymeric composite, doped with the copper (Cu) metal nanoparticle (NP)-dispersed carbon micro-nanofibers (ACF/CNFs) is synthesized as the electrode of an electrochemical cell. The cell is used for determining the quality (freshness) of fruits by detecting the ethylene gas that is evolved from fruits. Briefly, the composite material was prepared by dispersing a blend of Cu-ACF/CNFs and the aqueous mixture of cellulose acetate phthalate and mannitol in the reaction mixture used for synthesizing polyvinyl alcohol (PVA) by esterification, at the incipience of the PVA gel formation. The Cu-ACF/CNFs were separately prepared by chemical vapor deposition (CVD) using ACF as the substrate, the Cu NPs as the CVD catalyst and acetylene as the carbon-source. The prepared electrode material was characterized using different techniques such as scanning electron microscopy, energy dispersive x-rays spectroscopy, atomic force microscopy, fourier transform infrared spectroscopy, and x-ray photoelectron spectroscopy. The evolved ethylene gas molecules from fruit samples was detected using electrochemical measurements for the electrical resistance and differential pulse voltametry response of the sample. The proposed method of synthesis is simple and economically viable, and the response of the fabricated sensor in determining the ripening of fruits is fast.