Silver antibacterial properties influenced by pulsed electrodeposition frequency

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Some methods to explore the antibacterial properties of silver have been reported. These methods have included electrochemical techniques or electroless processes and the use of different substrates: high density polyethylene nets[1], activated carbon[2-4], zeolite[5] and cellulose nanocrystals[6], for example.

Regarding this, we have previously reported the surface characterization and bactericidal properties of electrodeposits of silver over activated carbon particles.[4] Silver deposits were obtained from nitrate solutions using an electrochemical pulsed bed reactor operated at different values of both current intensity and electrolyte flow rate. Carbon/silver samples were obtained by two different electrodeposition strategies: in the first case, the effect of both current intensity and electrolyte flow rate over silver deposition was investigated by keeping the particles still while applying different currents at various electrolyte flow rates; the second case involved a series of current pulses applied to the samples until total deposition time was covered, after each pulse, the particles were repositioned (without current) by fluidization due to changes in the direction of the electrolyte flow.[4]

The system described above allowed us to report antibacterial properties for all samples obtained. These properties showed dependency on both the operating conditions of the reactor and the applied electroplating strategy. In general, samples obtained by pulsed plating achieved higher bactericidal efficacy rather than samples which were kept still. Sample with the highest antimicrobial activity towards E. coli indicated reductions of up to 7 orders of magnitude in the log CFU/mL in just 10 min contact time and silver contents of 2.47 % wt. To get this sample, 50 g carbon (mesh 10) was loaded into the reactor and 0.4 A was applied for each 30 seconds pulse plating at 1.1 L/min electrolyte flow. Total deposition time was 600 s. Fig. 1 shows the used strategy to get this sample.

The aim of this new research is to explore possible variations over the antibacterial properties due only to changes on the electroplating pulsed time taking as starting point the carbon/silver sample described above. Thus, we have prepared samples analogously to the scheme showed in fig. 1 increasing or decreasing the deposition time in order to complete the same total deposition time (600 s) keeping all the other conditions in the reactor without any modification.

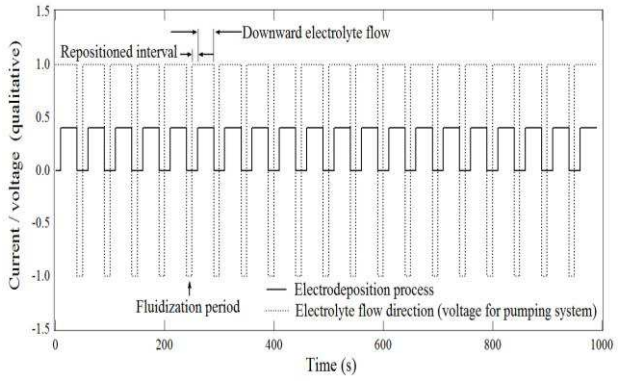

Fig.1. Followed strategy to apply current and fluidization pulses in electrochemical reactor.

Preliminary results have indicated a strong influence of the pulse frequency over bactericidal properties. Surface characterization and antimicrobial testing will provide further information to confirm this effect.

References

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