NANOPARTICLE BASED WOUND DRESSINGS WITH MICROWAVE-ENHANCED ANTIMICROBIAL FUNCTION

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INTRODUCTION:

The purpose of this project is to develop a system capable of eliminating the bacterial infection in clinical environment, by means of new type of wound dressing based on macroporous polymer hydrogel matrix. The matrix has embedded conductive nanoparticles with antimicrobial and bactericidal activity, which can be enhanced by external application of microwaves.

MATERIALS AND METHODS:

Cryogel is a sponge-like, water-based polymer material that is produced by freezing process. During freezing stage of the cryogelation process ice crystals form and then melt at the following defrosting stage. This leads to a loss of ice crystals in the cryogel and creates highly porous structure that is clearly shown on the SEM pictures.

RESULTS:

At initial stage we have been focused on methods of development of gold and silver nanoparticles, synthesis of cryogel that will make up the core of the wound dressings, and we have developed a protocol for incorporating fabricated nanoparticles into cryogel matrix.

The synthesis of gold nanoparticles for this method has been realised through Turkevich method, which is one of the oldest and most commonly used procedures for obtaining gold nanoparticles of 10-15 nm diameter in water [1].

Silver nanoparticles have been synthesised using sodium borohydride reduction of silver nitrate [2] according to the reaction:

$AgNO_3 + NaBH_4$à $Ag + ½ H_2 + ½ B_2H_6 + NaNO_3$

Micrographs of metal nanoparticles synthesised are shown in Fig. 1.

At the next stage of the project the research was focused on conjugating the gold nanoparticles to the surface or the pore walls of a gelatin cryogel through covalent bonds. This was done in order to make sure that the nanoparticles do not get detached from the polymer matrix. Cryogel is a sponge-like, water-based porous polymer hydrogel that is produced in a frozen solution. The ice crystals formed function as a pore forming substance creating a highly porous interconnected structure (Fig. 2).

SUMMARY OF WORK.

A variety of polymer cryogels suitable for wound dressings was achieved.

Several types of nanostructures suitable for the project goals have been produced including triangular and circular nanoparticles of gold and silver.

The nanoparticle size and structure was studied.

Conjugation of selected nanoparticles to the synthetic wound dressing was achieved.

ACKNOWLEDGMENTS.

This project has been supported by a research grant of the Ministry of Education and Science of the Republic of Kazakhstan. The project is carried out jointly with the Biomaterials Research Group of the University of Brighton, UK. The authors thank Dr. Iain U. Allan and Dr. Matt Illsley for their collaboration.