ANTIMICROBIAL PROPERTIES OF SULFUR CONTAINING COATINGS

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ABSTRACT

Organic materials used for packing food products prevent the access of microorganisms or gases, like oxygen or water vapor. To prolong the stability of products, preservatives such as sulfur dioxide, sulfites, benzoates, nitrites, and many other chemical compounds are used. To eliminate or limit the amount of preservatives added to food, so called active packaging is sought for, which would limit the development of microorganisms. Such packaging can be achieved, among others, by plasma modification of a material to deposit on its surface substances inhibiting the growth of bacteria. In this work plasma modification was carried out in barrier discharge under atmospheric pressure. Sulfur dioxide or/and sodium oxide were used as the coating precursors. As a result of bacteriological studies it was found that sulfur containing coatings show a 16% inhibition of *Salmonella* bacteria growth and 8% inhibition of *Staphylococcus aureus* bacteria growth. Sodium containing coatings show worse (by 10%) inhibiting properties. Moreover, films with plasma deposited coatings show good sealing properties against water vapor.

RESULTS

Tab. 1. Sulfur content in samples

Type of modification	Total sulfur content in film [µg /g]	Non-linked sulfur [µg /g]
Unmodified film	76	17
Ar + 0.1% SO_2	620	32
Ar + 0.7% SO_2	1190	155
Ar + 1.4% SO_2	860	62
Ar + 0.1% SO_2 + Na_2O (T_s=600°C)	480	30

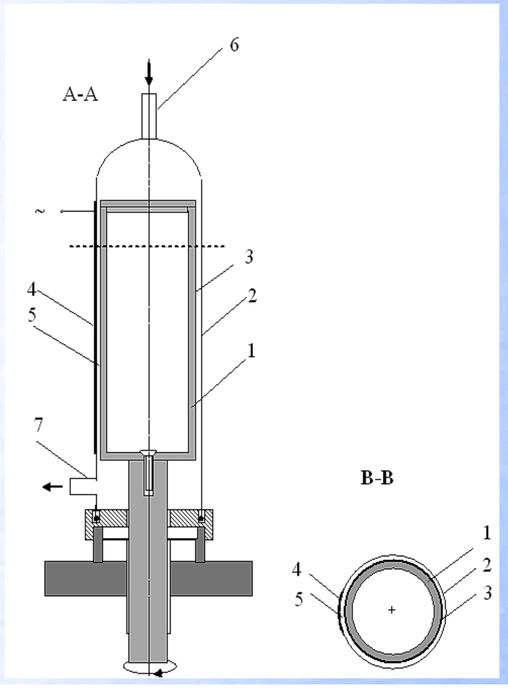

Fig.1. Scheme of the reactor [7]
A-A vertical section,
B-B horizontal section;
1 – rotating electrode,
2 – glass body, 3 – film,
4 – HV electrode, 5- discharge gap (2 mm),
6, 7 – inlet and outlet pipes, respectively

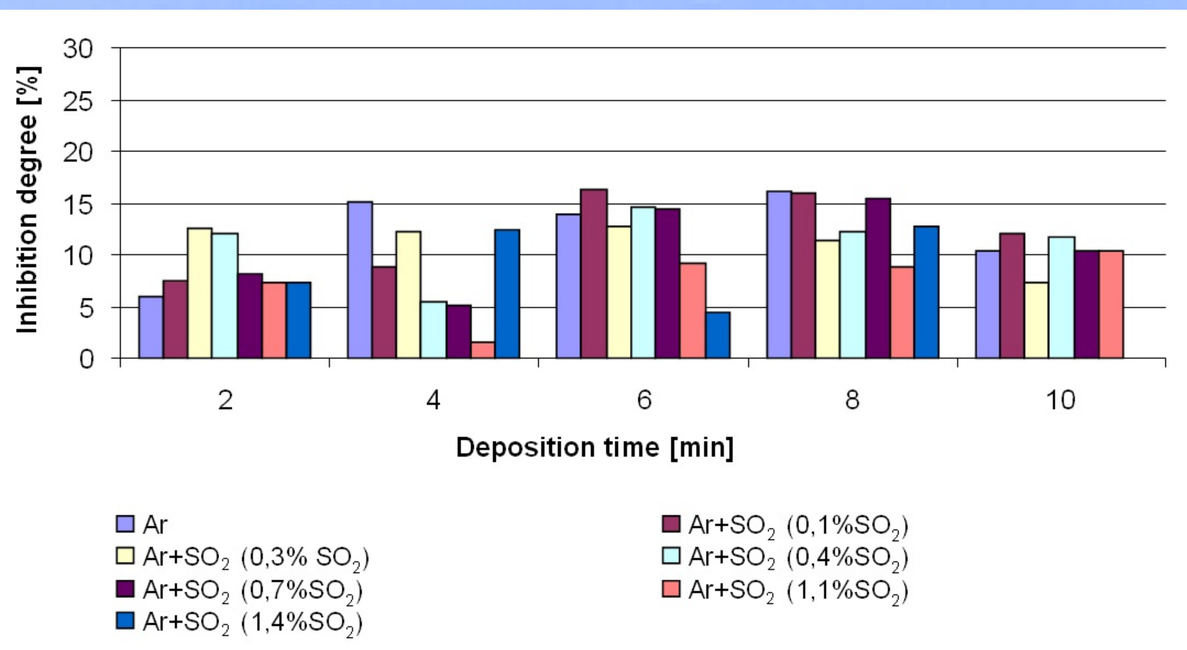

Fig. 2. Dependence of the degree of Salmonella bacteria development inhibition on the time of the film plasma modification in the Ar + (0-1.4%) SO_2 mixture.

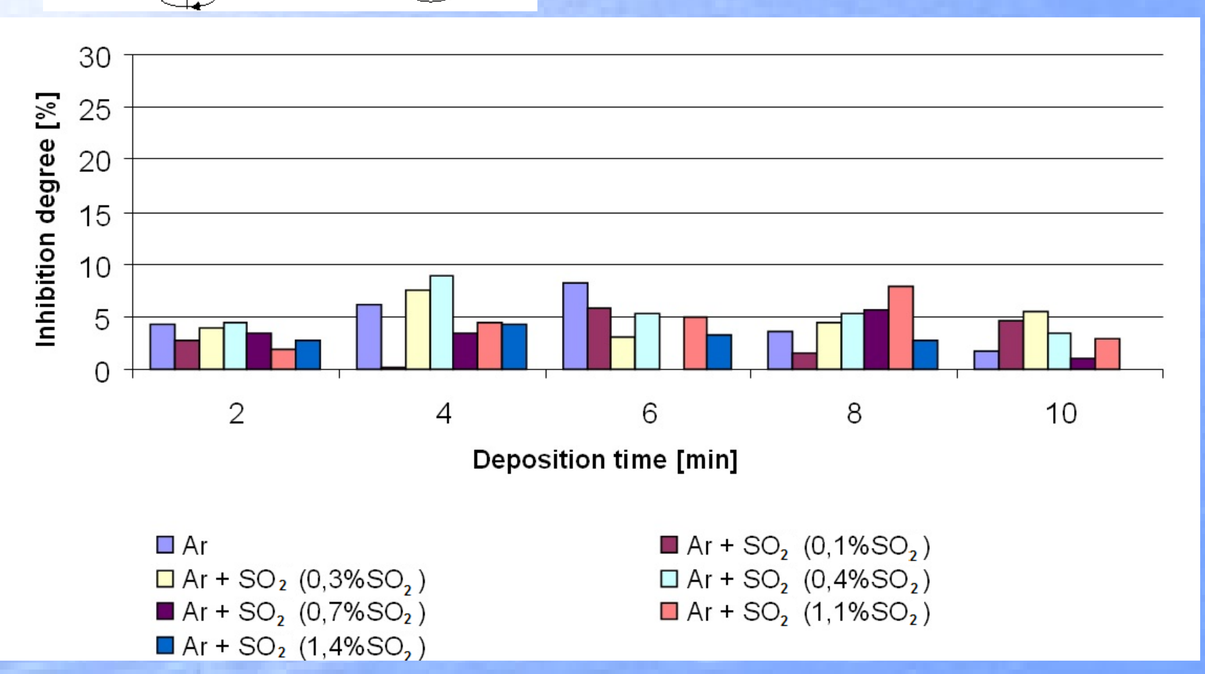

Fig.3. Dependence of the degree of Staphylococcus aureus bacteria development inhibition on the time of the film plasma modification in the Ar + (0-1.4%) SO_2 mixture

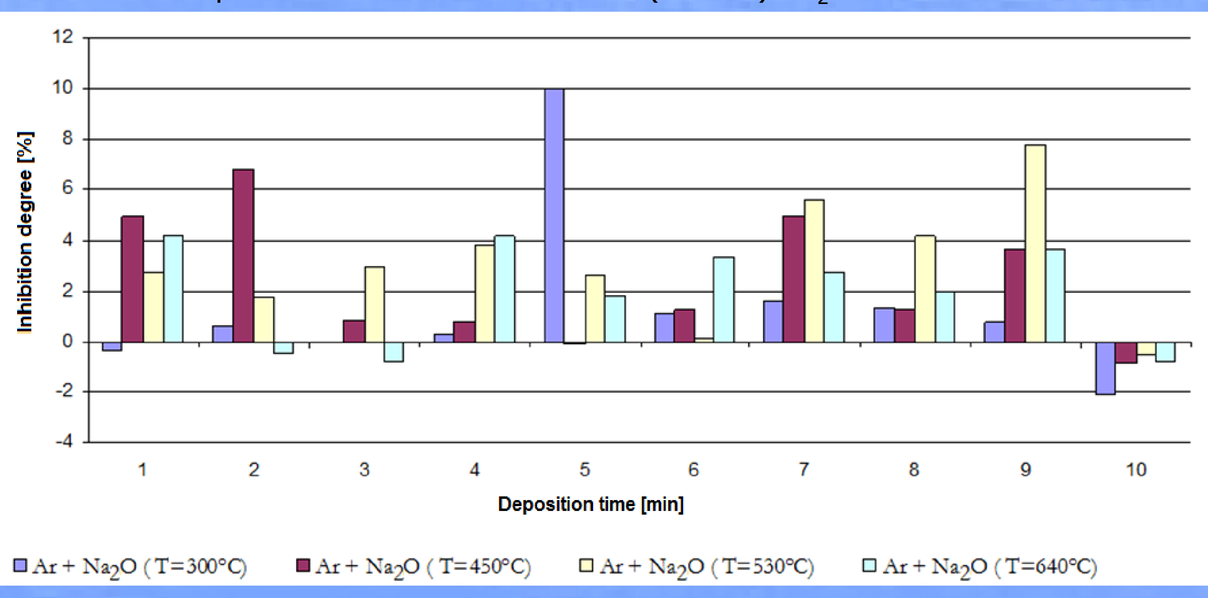

Fig. 4. Dependence of the degree of inhibition for *Salmonella* bacteria of samples of films modified in a mixture: Ar+Na_2O sublimed at 300, 450, 530 and 640°C.

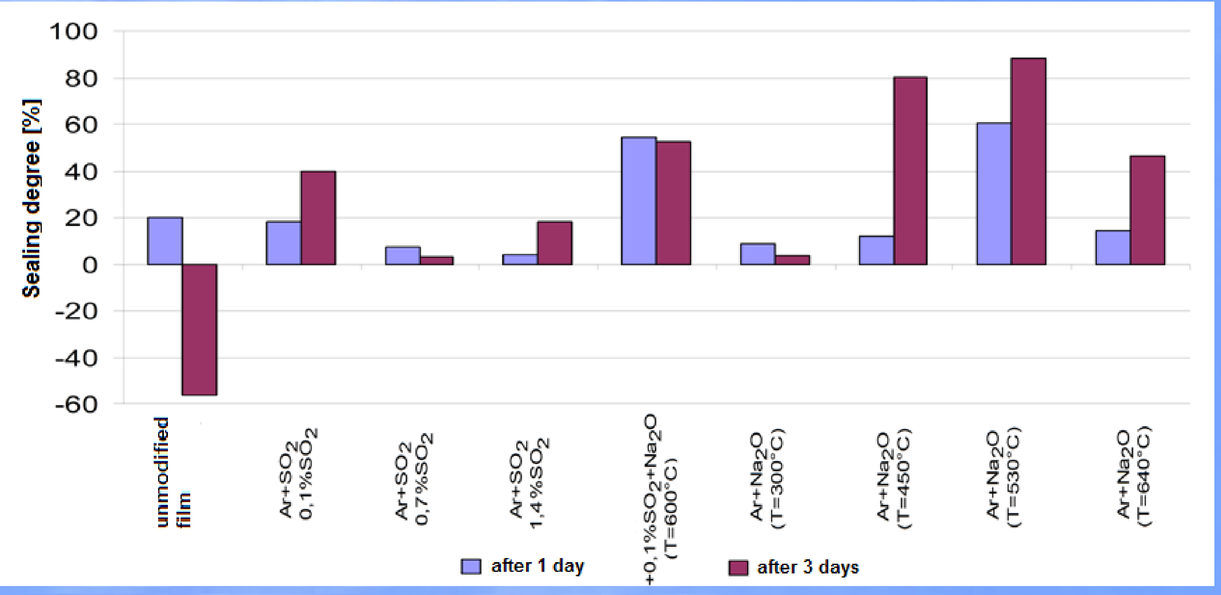

Fig. 5. Dependence of the sealing degree of the film towards water vapor on the type of modification; modification time of particular films = 6 min.

CONCLUSIONS

1. Sulfur or sodium containing coatings characterized by antimicrobial properties can be obtained by the PE-CVD method under atmospheric pressure.
2. The highest degree of inhibition of 16% for *Salmonella* bacteria of group Gram (-) and that of 8% for *Staphylococcus aureus* bacteria of group Gram (+), were achieved for films with sulfur containing (620 – 1190 µg /g) deposited from mixtures: Ar+0.1% SO_2 and Ar+0.7% SO_2.
3. Samples containing about 3 µg /g of sodium deposited from a mixture Ar+Na_2O sublimed at 300°C showed with, respect to *Salmonella* bacteria of group Gram (-), the inhibition degree of up to 10%.
4. Plasma deposited coatings were characterized by sealing properties towards water vapor, maximally at the level of 60%.
5. The films thus obtained may find application as packaging of food products.

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