The Influence of Low Temperature Sterilisation on Plastic Surface

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1. Introduction

Hydrogen peroxide (HP) sterilisation is generally considered to be clinically effective and safe germicidal procedure, because it is decomposed to oxygen and water easily. However, the results of our previous studies (Yoshida & Kobayashi, 2013) revealed various problems concerning to HP gas sterilisation, such as problems of environmental exposure of higher concentration, residual HP on sterilised items, deterioration of the items, false reaction of the chemical indicator (CI) in the pouch of reusable items already sterilised and used, and residual hydrogen peroxide on plastic materials after sterilisation [1-5]. Based on our previous research, the current study will examine the influence of four kinds of low-temperature sterilisations on the plastic surfaces with a scanning electron microscope in order to identify the macroscopic changes of reusable plastic items after HP sterilisation.

2. Method

The influence of two kinds of hydrogen peroxide sterilisations (low-temperature hydrogen peroxide gas plasma steriliser (LTHPGP) and low-temperature hydrogen peroxide vapour steriliser (LTHPV)), ethylene oxide gas sterilisation (EOG) and low temperature steam formaldehyde sterilisation (LTSF) on the surface of eleven kinds of plastic panels were evaluated by scanning electron microscope findings (SEMF). The Plastic panels tested were polyetherimide (PEI), polyethylene (PE), polytetrafluoroethylene (PTFE), nylon6 (PA6), nylon 66(PA66), polyethylene terephthalate (PET), polyetheretherketone (PEEK), thermoplastic polyurethane (TPU), polymethylmethacrylate (PMMA), polypropylene (PP), and polycarbonate (PC). 10×10×6mm blocks of them were evaluated by SEMF. When the influence of sterilisation on the surface was apparent, the other one or two blocks were re-evaluated to confirm the influence.

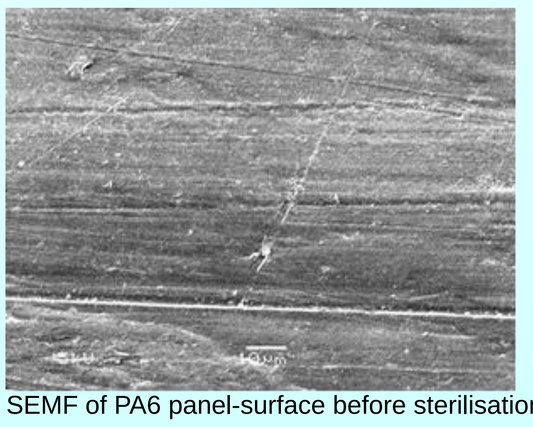

Figure 1-1. SEMF of PA6 panel-surface before sterilisation (×1000)

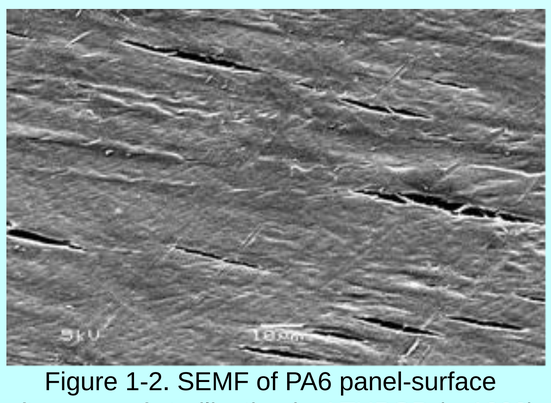

Figure 1-2. SEMF of PA6 panel-surface after once of sterilisation by LTHPGP (×1000)

Figure 1-3. SEMF of PA6 panel-surface after five repeated procedures of sterilisation by LTHPGP (×1000)

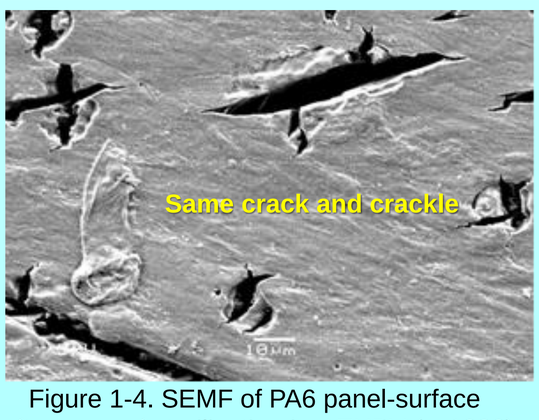

Figure 1-4. SEMF of PA6 panel-surface after once of sterilisation by LTHPV (×1000)

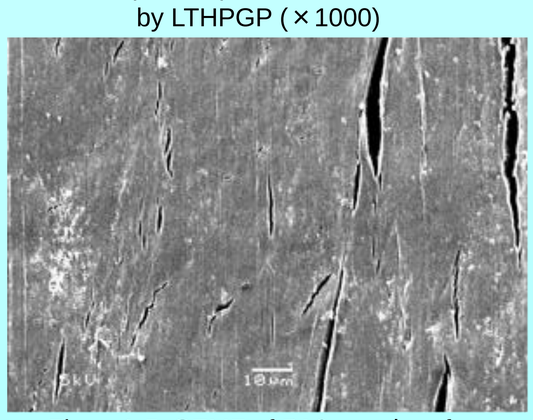

Figure1-5. SEMF of PA6 panel-surface after five repeated procedures of sterilisation by LTHPV (×1000)

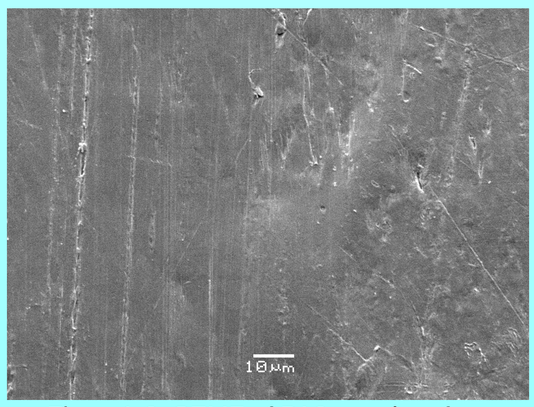

Figure1-6. SEMF of PA6 panel-surface after five repeated procedures of sterilisation by EOG (×1000)

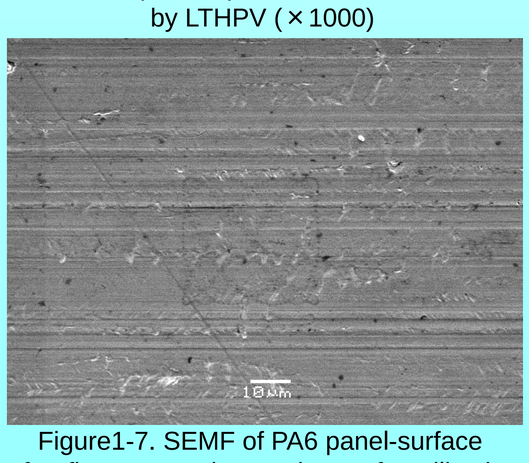

Figure1-7. SEMF of PA6 panel-surface after five repeated procedures of sterilisation by LTSF (×1000)

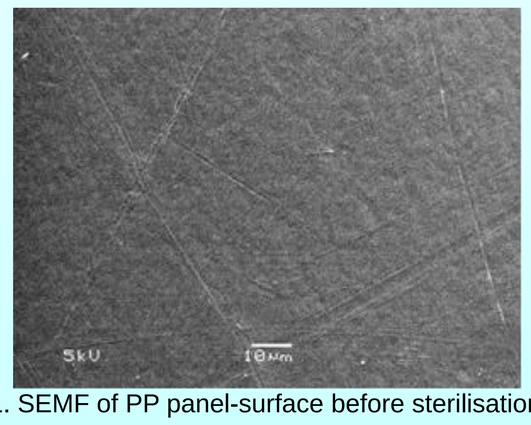

Figure 2-1. SEMF of PP panel-surface before sterilisation (×1000)

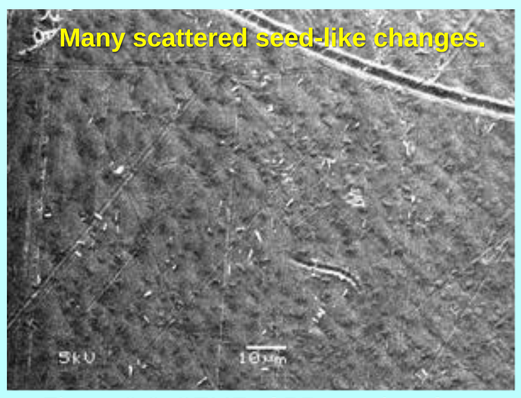

Figure 2-2. SEMF of PP panel-surface after five procedures of sterilisation by LTHPGP (×1000)

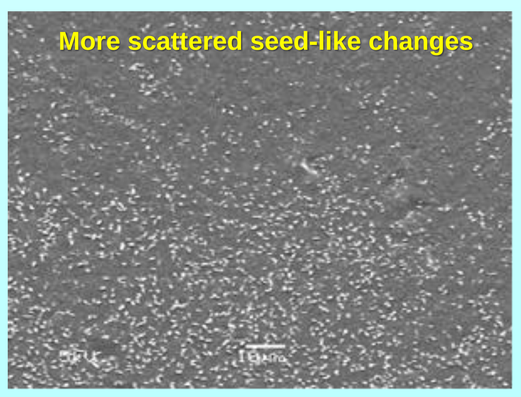

Figure 2-3. SEMF of PP panel-surface after five procedures of sterilisation by LTHPV (×1000)

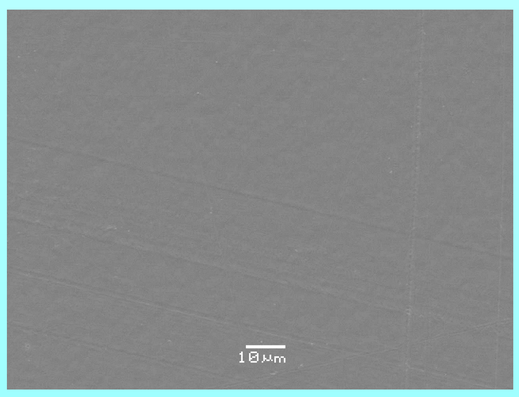

Figure 2-4. SEMF of PP panel-surface after five repeated procedures of sterilisation by EOG (×1000)

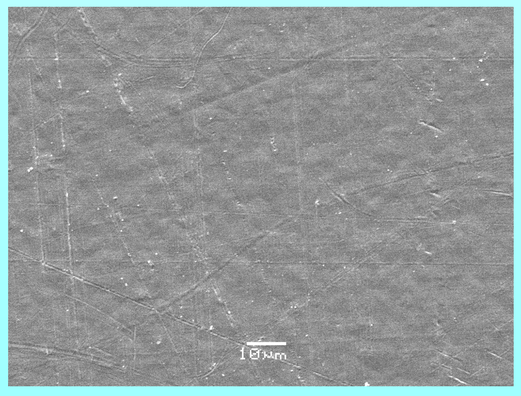

Figure 2-5. SEMF of PP panel-surface after five repeated procedures of sterilisation by LTSF (×1000)

3. Results

The results of the scanning electron microscopic finding (SEMF) are shown in Figures 1 to 2. On the surfaces of PA6 after the two types of HP gas sterilisations crack and crackle are occurred as shown Figure 1-2 to 1-5 after the sterilisations. And on the surfaces of PP, many scattered seed-like changes as were observed as in Figure 2-2 and 2-3 by the two types of HP gas sterilisations. On the surfaces of other plastic panels, no apparent changes were observed after the sterilisations. No changes were observed for the sterilisation of LTSF and EOG.

4. Discussion

The crucial factors causing the changes on some plastic panels after LTHPGP and LTHPV sterilisations could not be confirmed. It is speculated that chemical effect of HP vapour or physical reaction may play a role to some extent because no influence was found pre-vacuum. HP sterilisation procedures cause the changes in the plastic surfaces, even in a single procedure, and it may have influenced the plastic strength and structure in some cases. Although a further study is necessary to explain the cause, this study offers significant phenomena resulting from the sterilisation in medical settings. Conflict of interest statement: None declared.

5. Conclusion

LTHPGP and LTHPV sterilisations induced the structural changes of the surfaces of some plastic materials. However, the cause has not been identified yet. A further study is required to identify the cause.

References

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