Synopsis of Original Research Paper

Development of novel low-stimulus bio-adhesive materials and their application to cosmetics

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Skin-adhesive materials are expected to be applied to cosmetics such as nose packs or face masks. We have developed a novel biotissue-adhesive polymer complex consisting of poly(acrylic acid) (PAA) and poly(vinylpyrrolidone) (PVP). These polymers are both highly safe synthetic polymers approved as food, drug, and cosmetic excipients. When these polymers are directly mixed in a solution, they form a hydrophobic rigid complex, which does not adhere to tissues. Recently, we succeeded in preparation of a biotissue-adhesive PAA/PVP complex by a solid/solution interface mixing method. When a PAA film prepared on a plate was immersed in a PVP solution, it formed a highly swollen complex with PVP. The swollen PAA/PVP complex gel was dried up to a transparent film, which could be swollen again in water to form a soft bio-adhesive hydrogel.

Those two polymers are linked through hydrogen-bonding to each other, and neutralizing of the carboxyl groups of PAA molecule induces dissociation of the polymers. Thus, if the PAA/PVP complex film was put in a neutral buffer, it soon swelled and then slowly re-dissolved into a clear solution. The swelling and re-dissolving behavior of the PAA/PVP complex much depended on the molecular weight and crosslinking density of the polymers. The PAA/PVP mixing ratio affected the tissue-adhesion strength and mechanical strength of the water-swollen complexes. Complexes with higher content of PAA showed higher adhesion strength, while those made of an equal unit mol of PAA and PVP exhibited the highest mechanical strength.

PAA/PVP complex adhered to wet skin, and after dried up, it could be peeled off without stimulation. It could remove a large amount of blackheads from the skin, showing the high potential of the skin-adhesive complexes as low-stimulus facial- or nose-masks.