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Characterization of Optical and Structure Properties of Polydimethylsiloxanes

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Abstract. Polydimethylsiloxanes (PDMS), $(\text{CH}_3)_3\text{SiO}-[\text{Si}(\text{CH}_3)_2\text{O}]_n-\text{Si}(\text{CH}_3)_3$, known as silicone oil is a tamponade liquid which is very important in vitreoretinal surgery, especially in the treatment of complicated retinal detachment. Here, we investigated the optical properties and structure of silicone oil with high viscosity silicone oil of 5500 cSt and low viscosity silicone oil of 1300 cSt in order to understand the changing of physical properties of silicone oil before and after using in vitreoretinal surgery as a tamponade liquid and analyze the relationship between the tamponade duration and changed in silicone oil properties. From UV-Vis spectroscopy and refractometer measurement, it is found some changes in transmittance and refractive index values in both silicone oil after using as a tamponade liquid. From fourier transform infrared (FT-IR) spectroscopy, some additional of functional groups of N-H and O-H bond are observed at 1634.5 cm^{-1} and $3435.7 - 3764.5 \text{ cm}^{-1}$, respectively. The changes of optical and structure properties of silicone oil after using as a tamponade liquid are assumed to be responsible in emulsification of silicone oil and affect the transmittance quality at visible light spectrum. However, in this study, there is no linear correlation between tamponade duration and changed in silicone oil properties.

Introduction

Polydimethylsiloxanes (PDMS) known as a silicone oil is a tamponade liquid which is very important in vitreoretinal surgery especially in the treatment of complicated retinal detachment. The silicone liquid was firstly injected by Stone into the vitreous cavity of rabbits [1]. In 1962, Cibis *et al.*, introduced silicone oil in retinal surgery [2]. For the first time, Haut *et al.*, was tried the injection of silicone oil after vitrectomy in 1978 [3]. As vitreous substitutes, silicone oil has some valuable properties such as chemically stable in living systems, high surface tension, optically clear, biological and chemical inert, density similar to the natural vitreous, nonabsorbable characteristic and hydrophilic composition [4,5,6].

Silicone oils generally are divided in two types, silicone oil with high and low viscosity. Both types are frequently using as a vitreous substitute in vitreoretinal surgery. However, there are some possible emulsifications occurred in silicone oil after using in some periods. The emulsification can generate oil droplets that may cause secondary glaucoma, keratopathy and subjective disturbance [7]. Some expected factors causing emulsification are rheological characteristics, surfactant in the eye, eye movements, and impurities in the oil [8]. In any case, this emulsification affected patients have to substitute the silicone oil regularly. Some studies reported that silicone oil with high viscosity tend to be more stable in terms of emulsification than that of low viscosity silicone oil [7, 9].

Here, we characterized functional group and optical properties of silicone oil with high and low viscosity before and after using as a tamponade liquid by UV-Vis spectroscopy, refractometer and fourier transform infrared (FT-IR) spectroscopy to analyze the relationship between the tamponade duration and changed in silicone oil properties.