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It has been demonstrated that the erythrocytes (RBCs) oscillate during their tank-treading motion with high-frequency oscillations. This oscillatory motion drastically affects the dielectric and electrical properties of RBCs. Moreover, the glucose level in blood affects the electrical and dielectric properties of blood. It has been, also, shown that the frequency of these oscillations exponentially decrease from 1.2 MHz down to 0.85 MHz with variation of glucose level from 85 mg/dL up to 346.1 mg/dL. It is expected that these oscillations strongly affect the general physiological properties of blood and would stimulate the curiosity of scientists and bioengineers to present new, more efficient, rapid, safe and viable diagnostic and/or therapeutic methods for blood disorders; in particular diabetes. [doi:10.1063/1.3556986]

I. INTRODUCTION

Knowledge about micro-cells electrical and dielectric properties, through human blood, is essential for understanding the mechanisms by which several blood-disorders and maladies can occur. For example, any changes in blood motion (or any changes in blood physiology) should produce change in the blood electrical properties.[1] This principal has been used to assess the presence of various illnesses or conditions such as body fluid shift, blood flow, cardiac output and muscular dystrophy.[2] This can be carried out by various impedance diagnostic techniques, such as impedance cardiograph, plethysmography, and rheo-encephalography. Also, the biological function of the micro particles through blood will be strongly affected by the change of their physical properties: mass, volume, viscosity with serum, motion etc. For example, motion of red blood cells (RBCs) under viscous shear flow is characterized by the "tank-treading motion": It is steady membrane rotation with constant shape and inclination angle, and tumbling motion is observed as a rotational oscillation of the entire cell accompanied by tank treading motion.[3] The rotational motion, which is principally due to the cell membrane and occurs around the cell axis, has very low frequencies, f_L of about 1 – 5 Hz.[4] Another type of motion is the electro-rotation: When a colloidal (or bio-colloidal) solution is subjected to an external ac-electric field, the micro-particles will rotate by electro-rotation mechanism. Electro-rotation is a dielectric spectroscopy method for the characterization of dispersed colloids. The general cause of the particle rotation is a phase difference (PD) occurs between the electric field-induced polarization and the external rotating field.[5] The rotation speed could be calculated after: (i) the absolute value of the PD and (ii) the particle's induced dipole moment together with (iii) the viscosity frictional forces. Then, one can calculate the crossover frequency, f_0.[6] Similarly, the dielectric dispersion of suspensions can be obtained from the characteristics of the particle's bioimpedance and dielectric measurements.[7] So, both phenomena seem to be equivalent. A rigid correlation between electro-rotation and the dielectric dispersion of a suspension of the same particles should exist.[8,9] Moreover, Basuray and Chang[10] have demonstrated that the characteristic relaxation frequency of induced micro-dipoles by dielectrophoresis is inversely

