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## Nanoscale Lubrication in Model Biosystems as Rationalized in Terms of Fractons and Spectral-Mechanical Properties of Networked Biopolymers in Solutions

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A concept of a biopolymer network immersed within an aqueous solution as addressed in terms of flexibility vs. mechanical stability criterion has been proposed. It is based on a transmission of correlated wave of (hydrogen) ions emerging from breaking in a massive way the hydrogen bonds between the biopolymers, such as hyaluronan, and their non-ideal aqueous solution's surroundings.

Based on the argumentation presented in a paper by Reuveni et al. [1] it has been demonstrated that there exists a clear connection between the  $\ln(N)$  (a natural logarithm of the biopolymer length  $N$ ) and an inverse of a difference between two major contributions of this Landau-Peierls instability type paradigm. Providing that the so-called Alexander-Orbach conjecture for the oscillating biopolymeric system applies [2,3] one of the contributions is of mechanical nature, with an exponent  $g$  represented by  $1/(2-3g)$  whereas the other appears to be a surface-to-volume characteristic exponent, attaining preferentially a value of ca.  $2/3$  for a three-dimensional adjacent (articulating) space.

It has been shown in a numerical way that for  $N$  of the order of million(s) biopolymer's residues, for example for hyaluronan equivalent to its molecular weight of  $10^6$ - $6 \times 10^6$  Daltons, a measure of the best viscoelastic efficiency for the hyaluronan, there exists an equality  $\ln(N) = b/[1/(2-3g) - 2/3]$  that, for example, for  $N=10^6$  gives the value of mechanical exponent  $g$  close to  $1/3$ , yielding according to [3,4], an excellent passage of the (hydrogen) ions' wave derived from a breakage of the adjacent hydrogen bonds in the biopolymer-solution system of interest, provided that the constant  $b$ , according to [1], can be taken at  $b=4.5$ . (In general, for the exponent  $g > 1/6$  holds.) The first results seem to be promising when thoroughly rationalizing nanoscale friction-lubrication properties of biopolymer-solution articulating/confined subspaces exposed to very small nano-Newton loading conditions. For another thermomechanical scenario describing phase-transition and relaxation kinetics of a biopolymeric system, see [5].

### References

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