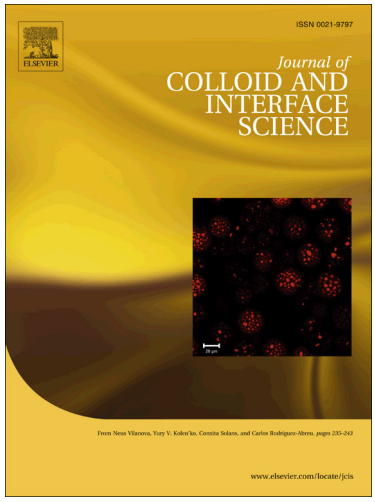

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Thermal transport characteristics of combined electroosmotic and pressure driven flow in soft nanofluidics

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Abstract

The present study deals with thermal transport characteristics of an electrolyte solution flowing through a slit nanochannel with polyelectrolyte walls, known as soft nanochannel. The sources of the fluid flow are the pressure gradient along the channel axis and the electrokinetic effects that trigger an electroosmotic flow under the impact of a uniformly applied electric field The polyelectrolyte layer (PEL) is denoted as a fixed charge layer (FCL) and the electrolyte ions can be present both inside and outside the PEL. Therefore, the PEL-electrolyte interface acts as a semi-penetrable membrane. To the best of our knowledge, the thermal analysis of mixed electrokinetically and pressure driven flow in such soft nanochannels has never been addressed. The Poisson-Boltzman equation is solved assuming the Debye-Huckel linearization for the low electric potential to provide us with analytical closed form solutions for the conservation equations. The conservation equations are solved to obtain the electric potential; velocity and temperature distributions in terms of governing dimensionless parameters. Also results for the Nusselt number are presented and discussed in detail.

Key words: Thermal Transport; Soft nanochannel, Electroosmotic flow, PEL

Nomenclature

Br	Brinkman number	y	transverse coordinate
d	PEL thickness	z	valence number of ions
e	proton charge		
E_x	electric field in the axial direction		
h	half channel height	*Greek symbols*	
J	Joule heating parameter	α	drag parameter of PEL
k	thermal conductivity	ε	electrolyte permittivity
k_b	Boltzmann constant	λ	EDL thickness

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