Characterization of Lymphocytes Using the Scanning Flow Cytometry

M. A. Yurkin[1, 2], **D. I. Strokotov**[1, 2], **K. V. Gilev**[1, 2], **D. R. van Bockstaele**[3], **A. G. Hoekstra**[4], **N. B. Rubtsov**[5], **and V. P. Maltsev**[1, 2, 6]

[1]Institute of Chemical Kinetics and Combustion, Institutskaya 3, Novosibirsk 630090, Russia
[2]Novosibirsk State University, Pirogova 2, 630090, Novosibirsk, Russia
[3]Esoterix, Clinical Trials Services, LabCorp, Gen. De Wittelaan L11-A2, B-2800 Mechelen, Belgium
[4]Faculty of Science, University of Amsterdam, Kruislaan 403, 1098 SJ, Amsterdam, The Netherlands
[5]Institute of Cytology and Genetics, Lavrentyeva 10, Novosibirsk 630090, Russia
[6]State Research Center of Virology and Biotechnology "VECTOR"
Koltsovo, Novosibirsk Region 630559, Russia

Abstract— A method to characterize individual mononuclear cells using light scattering patterns measured with a scanning flow cytometer has been developed. It is based on a coated sphere model and a global optimization algorithm DIRECT and provides not only parameter estimates but also rigorous estimates of its errors. The latter are obtained using Bayesian inference method taking into account correlation between residual errors. We applied this method to samples of T- and B-lymphocytes from several donors, determining cell diameter, ratio of nucleus to cell diameters, nucleus and cytoplasm refractive index for each cell. These parameters have potential diagnostic value, since they may be sensitive to certain disorders of the human immune system. The main difference in morphology of T- and B-lymphocytes was found to be the larger mean diameters of the latter. However, the difference is smaller than natural biological variability of a single cell type. We propose nucleus inhomogeneity as a possible reason for the deviation of real lymphocyte's light scattering patterns from that of a coated sphere model. This hypothesis is supported by several models simulated using the discrete dipole approximation.

ACKNOWLEDGMENT

This work was supported by the grants of the Russian Foundation for Basic Research, No. 07-04-00356-a, and No. 08-02-91954-NNIO-a, integration grants of the Siberian Branch of the Russian Academy of Science, No. 2009-37, and No. 2009-7, grant from the program of Presidium of the Russian Academy of Science, No. 2009-27b, and grant of the Novosibirsk city hall for young scientists.