create a voltage axial offset through the channel **49** that results in an electric field **60** that is oriented in a direction that is transverse to the lengthwise direction of the channel **49**.

[0032] The electric field **60** facilitates moving materials through the channel **49** between the inlet **52** and the outlet **54**. As an example, an axial component of the electric field **60** is oriented along the lengthwise direction of the channel **49** and functions to move material within the channel **49** towards the outlet **54**. A lateral component of the electric field **60** that is oriented in a direction perpendicular to the lengthwise direction of the channel **49** functions to drive the material toward the shallow side of the channel **49**. As can be appreciated, smaller sized materials will be driven farther into the shallow end of the channel **49** before interfering with the steps of the gradient, which facilitates separating the materials for the purpose of analysis. In this example, the device is electric-driven; however, in other examples, the device may be mechanically-driven by hydrostatic pressure or the like.

[0033] The elongated channel **49** and electric field **60** may be used for many different purposes. As an example, the elongated channel **49** may be used for the separation and metrology of nanomaterials, such as nanoparticles, biomolecules, or the like, via the injection of an analyte into the channel such that nanomaterials in the analyte are driven down the channel and across the width of the channel into the shallow side. The steps of the gradient of the channel exclude the nanomaterials by size within spatially separate regions of the channel. A size distribution of the nanomaterials may then be determined using fluorescence microscopy of other applicable technique.

[0034] Although a combination of features is shown in the illustrated examples, not all of them need to be combined to realize the benefits of various embodiments of this disclosure. In other words, a system designed according to an embodiment of this disclosure will not necessarily include all of the features shown in any one of the Figures or all of the portions schematically shown in the Figures. Moreover, selected features of one example embodiment may be combined with selected features of other example embodiments.

[0035] The preceding description is exemplary rather than limiting in nature. Variations and modifications to the disclosed examples may become apparent to those skilled in the art that do not necessarily depart from the essence of this disclosure. The scope of legal protection given to this disclosure can only be determined by studying the following claims.

What is claimed is:

1. A nanofabrication process for use with a photoresist that is disposed on a substrate, the process comprising:

a) exposing the photoresist to a grayscale radiation pattern of varied intensity;

b) developing the photoresist to remove irradiated portions therefrom (in the case of positive tone photoresist) or leave only irradiated portions (in the case of negative tone photoresist) and thereby form a photoresist etch mask with a patterned topography having a plurality of nanoscale critical dimensions; and

c) selectively etching the photoresist and the substrate by controlling an etching ratio between the substrate and the photoresist to thereby transfer a corresponding patterned topography having a plurality of nanoscale critical dimensions into the substrate.

2. The nanofabrication process as recited in claim **1**, wherein step (c) includes etching using an etchant gas mixture that comprises fluorinated gas and oxygen gas.

3. The nanofabrication process as recited in claim **2**, wherein step (c) further includes establishing a gas flow rate of the oxygen gas of about 10-25 standard cubic centimeters per minute.

4. The nanofabrication process as recited in claim **2**, wherein step (c) further includes controlling an amount of the oxygen gas in the etchant gas mixture to establish an etching selectivity of about 0.35-0.65, where the etching selectivity is a ratio of an etching removal rate of the substrate to an etching removal rate of the photoresist.

5. The nanofabrication process as recited in claim **4**, wherein step (c) includes establishing the etching removal rate of the substrate to be 20-30 nanometers per minute and establishing the etching removal rate of the photoresist to be 45-55 nanometers per minute.

6. The nanofabrication process as recited in claim **1**, wherein the plurality of nanoscale critical dimensions in the photoresist extend partially through the photoresist.

7. The nanofabrication process as recited in claim **1**, wherein step (a) includes forming the grayscale radiation pattern using a diffractive pattern on a photomask.

8. The nanofabrication process as recited in claim **1**, wherein step (c) includes transferring at least seven different nanoscale critical dimensions from the patterned topography of the photoresist into the substrate.

9. The nanofabrication process as recited in claim **1**, wherein step (c) includes forming an elongated channel having a channel width of macroscale dimension, with the plurality of nanoscale critical dimensions as a stepped gradient across the channel width.

10. A nanofabrication process for use with a photoresist that is disposed on a substrate and developed such that the photoresist includes a patterned topography having a plurality of nanoscale critical dimensions, the process comprising:

a) selectively etching the photoresist and the substrate using an etchant gas mixture to thereby transfer the a corresponding patterned topography having a plurality of nanoscale critical dimensions into the substrate; and

b) controlling an amount of oxygen in the etchant gas mixture to establish an etching selectivity of about 0.35-0.65, where the etching selectivity is a ratio of an etching removal rate of the substrate to an etching removal rate of the photoresist.

11. The nanofabrication process as recited in claim **10**, wherein step (a) includes etching using an etchant gas mixture that comprises fluorinated gas and oxygen gas.

12. The nanofabrication process as recited in claim **11**, wherein step (a) includes establishing a gas flow rate of the oxygen gas of about 10-25 standard cubic centimeters per minute.

13. The nanofabrication process as recited in claim **11**, wherein step (b) includes establishing the etching removal rate of the substrate to be 20-30 nanometers per minute and establishing the etching removal rate of the photoresist to be 45-55 nanometers per minute.