CLAIMS:

What is claimed is:

1. A polymerization process for forming polymer comprising:

contacting a monomer and a catalyst system in a reaction zone comprising at least one spiral heat exchanger and recovering polymer,

wherein the monomer, the catalyst system and polymer flow through the at least one spiral heat exchanger in a cross-flow direction relative to spirals of the at least one spiral heat exchanger,

wherein the Reynolds number of the flow of the solvent, monomer/comonomer, the catalyst system, and polymer is about 0.1 to about 2,200.

2. A polymerization process for forming polymer comprising:

contacting a monomer and a catalyst system in a reaction zone comprising at least one spiral heat exchanger and recovering polymer,

wherein the monomer, the catalyst system and polymer flow through the at least one spiral heat exchanger in a cross-flow direction relative to spirals of the at least one spiral heat exchanger;

wherein the process is a solution phase process; and

wherein a pressure drop across the at least one spiral heat exchanger is less than or equal to about 10 psi.

3. A polymerization process for forming polymer comprising:

contacting a monomer and a catalyst system in a reaction zone comprising at least one spiral heat exchanger and recovering polymer,

wherein the spiral heat exchanger comprises at least one spiral sheet spiraling radially around an axis of the spiral heat exchanger,

wherein the spiral heat exchanger comprises at least one channel formed in between adjacent spiralings of the at least one spiral sheet,

wherein the monomer, the catalyst system and polymer flow through the at least one channel in a cross-flow direction relative to spirals of the at least one spiral heat exchanger;

wherein the catalyst system comprises a catalyst compound and an activator; and

wherein the monomer comprises C_2 to C_{40} olefins.

4. The polymerization process of claim 1, wherein the process is a solution phase process.

5. The polymerization process of claim 1, wherein the process is a slurry phase process.

6. The polymerization process of claim 1, wherein the at least one spiral heat exchanger removes heat at a rate of about 7450 W/·cubic meters·°C.

7. The polymerization process of claim 1, wherein a pressure drop across the at least one spiral heat exchanger is less than or equal to about 10 psi.

8. The polymerization process of claim 1, further comprising recycling at least a portion of the monomer, the catalyst system and polymer exiting the at least one spiral heat exchanger back through a spiral heat exchanger, which may be the same or different spiral heat exchanger.

9. The polymerization process of claim 1, wherein polymer is produced with a recycle ratio of at least about 5.

10. The polymerization process of claim 1, wherein polymer is produced with a recycle ratio of from about 0.5 to about 20.

11. The polymerization process of claim 1, wherein the monomer, the catalyst system, and polymer are maintained substantially as a single liquid phase solution.

12. The polymerization process of claim 1, wherein polymer is produced at a rate of at least about 600 grams per liter of reactor volume.

13. The polymerization process of claim 1, wherein the at least one spiral heat exchanger comprises at least eight spiral heat exchangers connected in series.

14. The polymerization process of claim 1, wherein the process is a continuous process.

15. The polymerization process of claim 1, wherein the monomer comprises C_2 to C_{40} olefin.

16. The polymerization process of claim 15, wherein the C_2 to C_{40} olefin is selected from at least one of the group consisting of ethylene, propylene, butene, pentene, hexene, heptene, octene, nonene, decene, undecene, dodecene, and mixtures thereof.

17. The polymerization process of claim 1, wherein polymer is an ethylene polymer or a propylene polymer.

18. The polymerization process of claim 17, wherein polymer further comprises C_2 to C_{20} comonomer.

19. The polymerization process of claim 18, wherein the C_2 to C_{20} comonomer is selected from the group consisting of ethylene, propylene, butene, pentene, hexene, heptene, octene, nonene, decene, undecene, dodecene, and a mixture thereof.

20. The polymerization process of claim 1, wherein the catalyst system comprises a catalyst compound and an activator.

21. The polymerization process of claim 1, wherein the catalyst compound comprises a pyridyldiamido compound and/or a metallocene compound.

22. The polymerization process of claim 20, wherein the activator comprises alumoxane and/or a non-coordinating anion activator.

23. The polymerization process of claim 20, wherein the activator and the catalyst compound are contacted to form the catalyst system prior to entering the at least one spiral heat exchanger.

24. The polymerization process of claim 20, wherein the activator is introduced to a recycle stream comprising the monomer, the catalyst system and polymer.

25. The polymerization process of claim 3, wherein the spiral sheet includes at least one flow channel for flow of a heat exchange medium.