Iron (III) TriFluoroAcetylAcetonate; Polymerization Initiator

A. Alfakhry
Petroleum Engineering Department.

Abstract

The Polymerization of three chemicals was studied. Polymrizsgion of styrene was carried out within the temperature range of 50-70 ºC and Methyl Methacrylate (MMA) within the temperature range of 50-70 ºC and Vinyl Acetate within the temperature range of 50-60 ºC. All at different component ratios using as an initiating system TrifluoroAcetylAcetonate of iron(III) (TFAFe). The rates of Polymerization and effective values of activation energy were determined.

Keywords: *Current Conveyors, Self cascode, Composite transistor.*

1. Introduction

Such systems are much more effective at the Polymerization of vinyl monomers Benzoyl Peroxide(PB) separately (1) and have a selectivity in Polymerization of different monomers (2). The cause of a high initiating activity of these systems is strong mutual activation of the components decomposition which is dependent of their ratio nature and other factors (3).

2. Physical and Chemical properties

TFAFe is a red solid material with molecular weight of 515 and melting point of 110 -112 oC. TFAFe is air and moisture stable, no hazardous polymerization initiator. TFAFe has no odor and is not soluble in water. The material and safety data sheet for FATFe is attached. Uses TFAFe is no hazardous Polymerization initiator. It can be used alone or with other initiators. It is safe and no conditions to avoid. It is incompatible with oxidizing agents and active metals. TFAFe decomposes at high temperature resulting in carbon monoxide, organic fumes, carbonyl fluoride, hydrogen fluoride, and iron oxide products.

Polymerization of Styrene1

TFAFe and PB where utilized at different ratios to initiate the polymerization of styrene at 50 ºC and 70 ºC.

TFAFe/ BP	C_{TFAFe}	C_{BP}	Polymerization rate	% increase in polymerization rate
2.5:1	0.025	0.010	7.3	13.8
2:1	0.020	0.010	5.0	13.1
1:1	0.010	0.010	3.7	12.8
1:2	0.005	0.010	2.9	12.4
1:4	0.0025	0.010	2.4	11.0
1:10	0.001	0.010	1.9	10.0
0:1	0.000	0.010	1.8	10.7
10:1	0.025	0.0025	13.2	46.0
4:1	0.025	0.0625	14.6	41.4
2:1	0.025	0.0125	6.2	17.2
1:1	0.025	0.025	5.1	20.1
1:2	0.025	0.050	5.4	22.1
1:4	0.025	0.100	5.9	32.2
1:10	0.025	0.250	6.5	36.8

Polymerization of Methyl Methacrylate (MMA)2

TFAFe and PB where utilized at different ratios to initiate the polymerization of Methyl Methacrylate at 50 ºC and 70 ºC.

TFAFe/ BP	C TFAFe	C BP	Polymerization rate	% increase in polymerization rate
1:0	0.250	0.000	3.0	8.4
0:1	0.000	0.100	4.1	18.9
2.5:1	0.250	0.100	4.2	18.5
2:1	0.200	0.100	4.0	19.9
1:1	0.100	0.100	4.1	18.0
1:2	0.050	0.100	3.8	17.4
1:4	0.025	0.100	4.2	19.2
1:10	0.010	0.100	3.5	17.0
1:10	0.250	2.500	13.8	68.9
1:4	0.250	1.000	9.4	49.2
1:2	0.250	0.500	7.4	34.5
1:1	0.250	0.250	5.2	25.2
2:1	0.250	0.125	4.9	22.3
4:1	0.250	0.0625	3.6	15.3
10:1	0.250	0.025	4.1	13.1

Polymerization of Vinyl Acetate 3

In this work, vinyl acetate was polymerized in presence of different combinations of TFAFe and benzyl peroxide at 50 oC and 60 oC. The rate of polymerization shows a linear increase with the square root of TFAFe concentration.

TFAFe / BP	C_{TFAFe}	C_{BP}	Polymerization rate	% increase in polymerization rate
0:1	0.000	0.01	3.0	8.3
2.5:1	0.250	0.01	3.9	9.0
2:1	0.020	0.01	3.6	8.6
1:1	0.010	0.01	2.7	7.0
1:2	0.005	0.01	2.3	6.1
1:4	0.0025	0.01	1.8	5.5
1:10	0.001	0.01	1.7	4.4

3. Mechanisms

Three mechanisms were suggested to explain how TFAFe works. These mechanisms are classified according to TFAFe availability as follows:

1 – TFAFe is in excess.

This mechanism can be realized in excess of TFAFe. When TFAFe is in excess (2: 1) the order of the reaction was determined at 1.5 which indicates the participation of monomer in the initiation of reaction.

TFAFe + Monomer → complex → polymer

This mechanism leads to the formation of lower molecular weight polymers.

2 – Equal Molar Ratio of Initiators

This mechanism predominates at equip molar ratio of TFAFe and PB and at limited excess of Benzyl Peroxide (PB) i.e. 1:1 up to 1:4. In this case, the participation of monomer is limited. TFAFe: PB complex plays the main role in the initiation reaction. At a ratio of 1:4, the consumption rate of TFAFe and PB was found to be equal.

TFAFe + PB → Complex + M → Triple Complex → polymer

3 – Excess of PB

This mechanism is realized at a great excess of BP i.e. at a ratio of 1:10 or more. This mechanism is confirmed by the reaction rate and effective energy of reaction is the same as that obtained using pure PB.

PB + M →Polymer

4. Conclusion

TFAFe was utilized in the polymerization of three chemicals; styrene, vinyl acetate and Methyl Methacrylate. Three different mechanisms were suggested to explain the mechanisms that TFAFe is expected to work. These mechanisms depend mainly on the percentage of TFAFe in the reaction mixture. also suitable for low-voltage design of other current-output-based active devices, such as current conveyor based operational amplifiers.

References

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